MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 36 SEPTEMBER, 1929 Number 1

PRINCIPAL ARTICLES IN THIS NUMBER

Die Clearances for Blanking Aluminum—*By E. J. Rodee* 1
Records that Help to Reduce Accidents—*By A. H. Rodrick* 6
Milling Automobile Steering Knuckles—*By Charles D. Oesterlein* 8
Indexing Head for Highly Accurate Spacing—*By Freeman C. Duston* 14
Current Editorial Comment 18
Selecting Small Tools by Tests—Inexperience Causes Breakdowns—Reducing Mistakes in the Shop—Economical Machine Design
The Best Equipped Machine Shop in the World 19
Ingenious Mechanical Movements 20
Common Sense in Helical Spring Design—*By A. B. Cox* 22
Standardized Jigs for Production Drilling—*By C. B. Cole* 24
Special Tools and Devices for Railway Shops 31
Cutting Costs with a Tool Control System—*By L. H. Tenney* 33
Converting Chips into Real Profits—*By Charles O. Herb* 41
The British Metal-working Industries 51
A Lathe Mandrel of Many Uses 52
Sheet-Metal Rolling and Forming Methods—*By Frank H. Mayoh* 53
Prize Contest Announcement 56
Use of Concrete in Machine Construction—*By Charles B. Irmer* 57
Conducting Successful Foremen Conferences 61
Universal Air Cylinder for Milling Machine—*By J. E. Fenno* 62
Lapping Ball-bearing Raceways—*By H. J. Wills* 65
The National Metal Congress and Exposition 66

DEPARTMENTS

What MACHINERY'S Readers Think 12
Notes and Comment on Engineering Topics 17
Letters on Practical Subjects 43
Shop and Drafting-room Kinks 49
Questions and Answers 50
New Machinery and Shop Equipment 67

Total Distribution for August, 17,171 Copies

Product Index 332-354 Advertisers Index 357-358

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ALEXANDER LUCHARS, President ROBERT B. LUCHARS, Vice-President EDGAR A. BECKER, Treasurer
ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor CHARLES O. HERB, Assistant Editor FREEMAN C. DUSTON, Assistant Editor
LONDON: 52 Chancery Lane PARIS: 15 Rue Bleue

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Copyright 1929 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

HEALD Automatic INTERNAL GRINDERS

LE BLOND

Says, "Excellent Investment even where the lots are small"

"The Size-Matic machine has been one of the best investments that we have made for speeding up production in the manufacture of gears for our geared head-stock machines. The fact that it is entirely automatic does not in any way militate against the machine for short lots. As a matter of fact, we can set this machine up for ten to twenty pieces and beat the old method of grinding with the hand gauging and plugging.

For Small Lots

"We repeat the statement that this machine is one of the best investments that we have ever made in the way of machine tools in this shop."

As an Investment

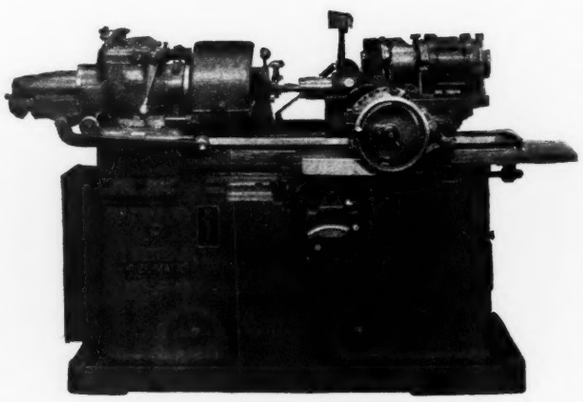
Above is from a letter in our files dated July 27, 1929.

Admitted as the last word among mass producers, the above remarks from the R. K. LeBlond Machine Tool Company are typical of what a score of other shops think of the Heald Automatics for small lot work.

Regardless of what your internal grinding is, send us samples and let us give you data on what an automatic *will do for you.*

The Heald Machine Co., Worcester, Mass., U.S.A.

HEALD

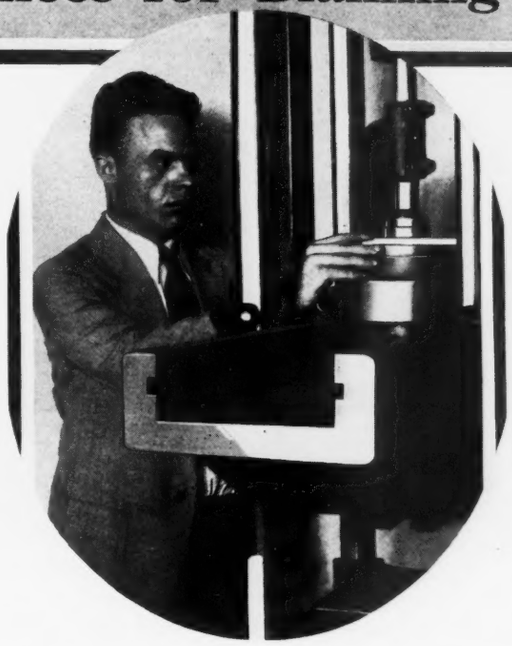


Only a Heald is Automatic

MACHINERY

Volume 36 NEW YORK, SEPTEMBER, 1929 Number 1

Die Clearances for Blanking Aluminum



Results of Laboratory Tests Made to Determine the Correct Die Clearances to be Used for Blanking Aluminum and Aluminum Alloys

By E. J. RODEE
Testing Engineer, Physical Testing Division, Research Depart., Aluminum Co. of America

IN the blanking and shearing of metals it has been common practice to have nearly a metal to metal fit between the punch and die. The results obtained in blanking hot- and cold-rolled steel with dies having various amounts of clearance were described in May, 1927, MACHINERY, page 641. These results showed that clearance was necessary between the punch and die in order to obtain a smooth edge on the blank and the hole in the steel. As far as aluminum and its alloys are concerned, however, there has been little published regarding the correct clearances for shearing and blanking operations.

When shearing, punching, or blanking wrought aluminum by the methods followed in the past, a rough surface on the sheared edges of the material has invariably been obtained. This is most noticeable on the thicker material, where one can readily see the ragged and torn surfaces on the sheared edge. Examination with a magnifying glass will reveal, in most cases, exactly the same conditions on the edges of the thinner sheets.

Why a Smooth-edged Blank is Desired

It is believed that smooth surfaces on the edges of blanks for making various products would eliminate many of the difficulties caused by cracking of the edge or the formation of burrs, in operations following the blanking operation. Blanks for making tubing by the cupping process, blanks for cooking utensils and trimmed hot mill slabs are among the products with which trouble of this kind is experienced.

Very little has been published on the correct clearances to be used for dies for shearing and blanking aluminum. The results obtained in blanking steel with dies having varying amounts of clearance were thoroughly discussed in the article "What Happens in Shearing Metal" published in May, 1927, MACHINERY. Aluminum, however, acts quite differently from steel, and frequently, when shearing, punching, or blanking this metal, a rough surface is obtained on the sheared edges. The present article, therefore, will prove of special value as an original contribution to engineering literature. It gives the results of laboratory tests conducted for the specific purpose of determining the correct die clearances to be used for blanking aluminum as well as aluminum alloy sheets.

The object in making the tests described in this article was to determine the proper clearances to use when shearing aluminum sheets and various kinds of aluminum alloy sheets of different thicknesses. It was also considered desirable to determine the loads necessary to punch out blanks of a given size and thus determine the shearing strength of the metals.

Kinds of Materials Tested

The samples tested were rolled in the New Kensington and Arnold Sheet Mills of the Aluminum Company of America. Samples in thicknesses of 1/64, 1/32, 1/16, 1/8, and 1/4 inch were rolled in each of the grades and tempers identified by the designations adopted by the company, as listed in Tables 1 and 2.

The material used was part of a considerable lot of samples that were carefully prepared to form a group representative of the usual commercial product, due attention being paid to chemical composition and mechanical properties.

Methods Used in Testing Materials

Tensile tests were made on all materials to determine their physical properties. An experimental punch press was made as shown in Fig. 11 for performing the shearing operations. The die

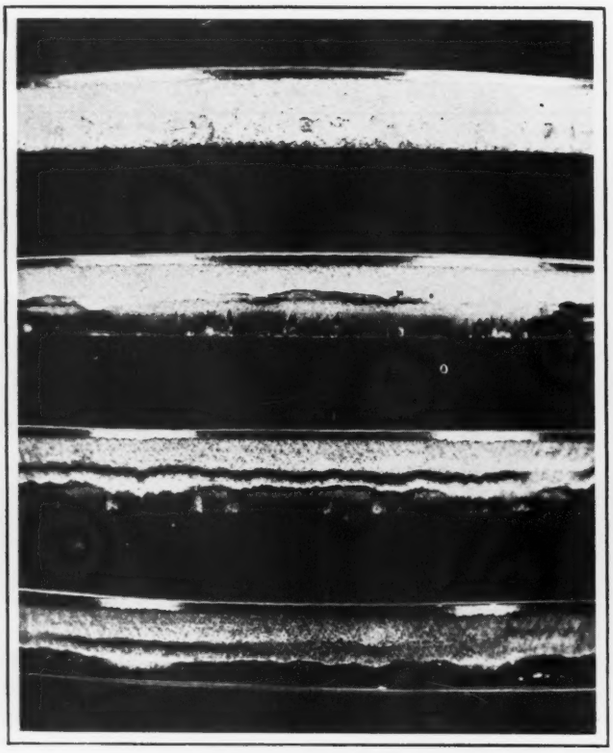


Fig. 1. Sheared Edges of 25SO Aluminum Blanks, 1/4 Inch Thick, Produced with Dies Having Different Clearances. Reading from Top to Bottom, Ratios of Die Clearance to Stock Thickness are 13.0, 7.8, 4.8, 3.0 Per Cent

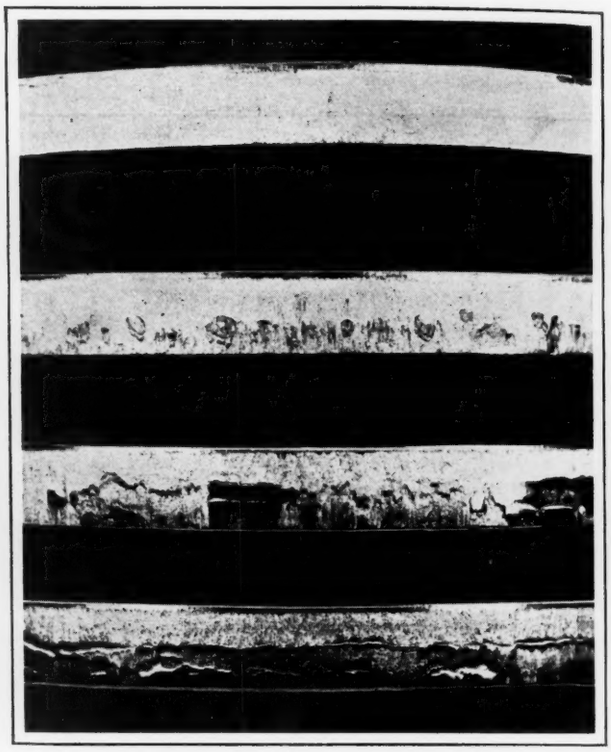


Fig. 2. Sheared Edges of 25SW Aluminum Blanks, 1/4 Inch Thick, Produced with Dies Having Different Clearances. Reading from Top to Bottom, Ratios of Die Clearance to Stock Thickness are 13.0, 7.8, 4.8, 3.0 Per Cent

for this press was 2.750 inches in diameter, and seven punches were provided, varying in size from 2.748 to 2.685 inches in diameter. The press was so constructed that it could be placed in the 100,000-pound capacity Amsler testing machine with which the loads were applied.

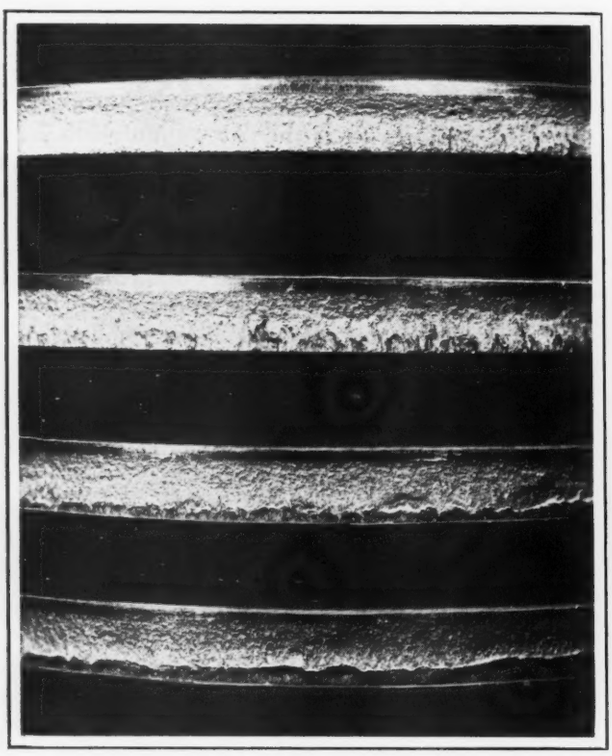


Fig. 3. Sheared Edges of 2SO Aluminum Blanks, 1/4 Inch Thick, Produced by Dies Having the Same Variations in Clearance as Those Employed for the Four Blanks Illustrated in Fig. 1

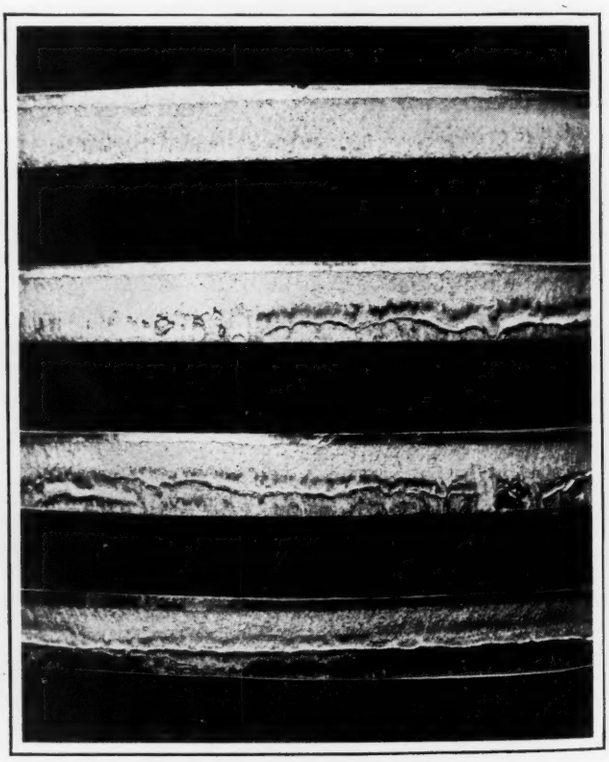


Fig. 4. Four 2SH Aluminum Blanks, 1/4 Inch Thick, Produced with Dies Having the Same Variations in Clearance as Those Employed for the Blanks Shown in the Preceding Illustration

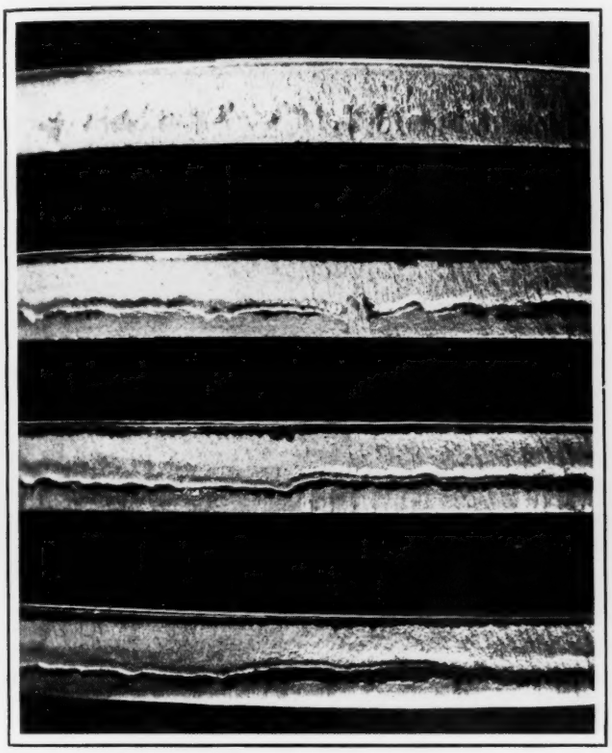


Fig. 5. Edges of 17SO Aluminum Blanks, 1/4 Inch Thick, Produced by Dies Having Same Variations in Clearance as Those Used for Blanks Shown in Other Illustrations

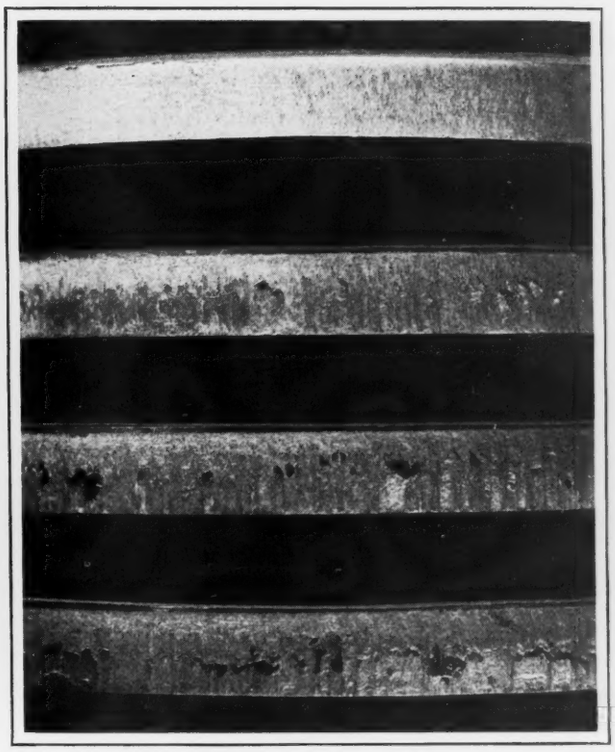


Fig. 6. Sheared Edges of 17ST Aluminum Blanks, 1/4 Inch Thick, Produced with Same Die Clearances as Used in Blanking the Specimens Shown in Figs. 1 to 5

Five specimens were blanked from each thickness of each grade and temper of sheet tested, using different clearances between the punch and die. Maximum loads were taken for each specimen tested, and from these values the ultimate shear strength of the metal was computed.

Fig. 7. Acid-etched Cross-section of Sheared Edge of a 2SO Aluminum Blank (Magnified Fifteen Times)

Fig. 8. Central Part of Sample in Fig. 7, Magnified 100 Times, to Show Metal Flow and Cracks Caused by Shearing

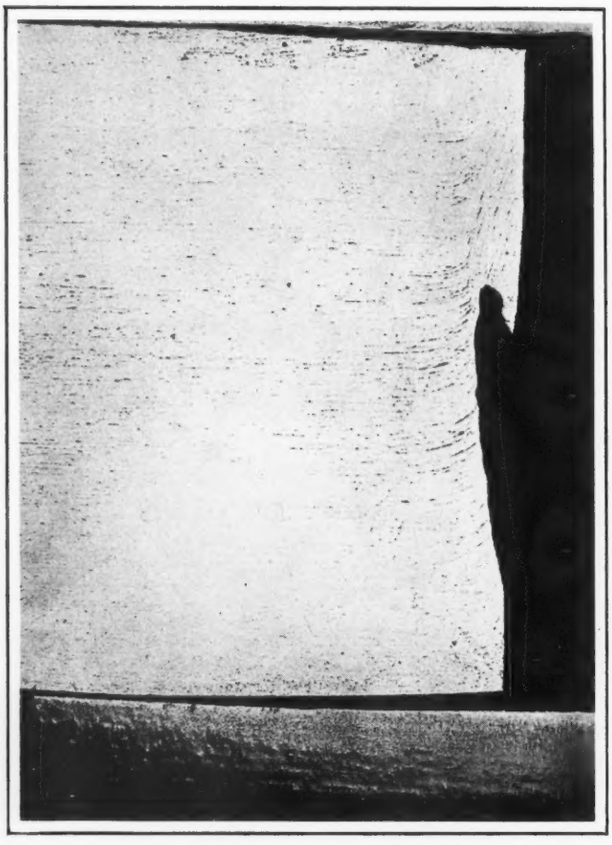


Fig. 9. A Piece of a 2SH Aluminum Slab Cut and Etched to Show the Metal Flow Resulting from the Shearing Operation (Magnification Fifteen Times)

Fig. 10. Portion of Section Shown in Fig. 9 Magnified 100 Times. Note Small Crack Associated with Flow Area Outlined by Lines of Constituent

Maximum and Minimum Clearance for Satisfactory Results

Table 1 gives the maximum and minimum ratios of clearance to thickness between the punch and die which were found to produce smooth sheared surfaces. The average of these values is given in the second column.

The results indicated that the larger clearances are satisfactory for thick sheets, but for sheets under 1/8 inch in thickness the clearance should be as near the average value as it is practical to make it. The tables give results only for those blanks that had smooth edges and no burrs, or slight burrs.

Figs. 1 to 6, inclusive, show quite clearly the effect of different clearances upon the blanked edges of the disks. Table 2 gives the tensile and shearing strength of the different kinds and tempers of aluminum used in the tests. The ratio between the tensile and the shearing strength is expressed in per cent of the tensile strength.

Table 1. Die Clearance Limits within which Smooth Sheared Surfaces were Obtained on Aluminum Blanks

Material Tested*	Average Ratio of Clearance to Thickness of Stock	Maximum Ratio of Clearance to Thickness of Stock	Minimum Ratio of Clearance to Thickness of Stock
2SO	0.103	0.119	0.095
2S4	0.139	0.156	0.081
2SH	0.144	0.194	0.102
3SO	0.103	0.126	0.078
3S4	0.134	0.156	0.109
3SH	0.131	0.150	0.110
51S-O	0.132	0.145	0.119
51S-W	0.123	0.147	0.096
51S-T	0.109	0.121	0.098
25S-O	0.154	0.188	0.130
25S-W	0.151	0.180	0.130
25S-T	0.145	0.157	0.126
17S-O	0.143	0.155	0.131
17S-T	0.142	0.155	0.119
C17S-T	0.153	0.158	0.145

Machinery

*Manufacturer's designation for kind and temper of material tested—See Table 2. The thickness of the materials tested ranged from 1/64 to 1/4 inch inclusive.

Table 2. Shear and Tensile Strength of Aluminum Specimens Tested

Material Tested*	Tensile Strength, Pounds per Square Inch†	Shear Strength, Pounds per Square Inch	Ratio of Shear Strength to Tensile Strength, Expressed in Percentage	Brinell Hardness Number
2SO	13,730	9,610	70.0	24.2
2S4	18,890	11,320	60.0	27.4
2SH	25,730	13,935	54.2	43.6
3S0	16,025	10,700	66.8	28.2
3S4	22,670	12,960	57.1	41.1
3SH	28,840	15,015	52.1	52.0
51S-O	14,615	10,600	72.5	26.1
51S-W	34,920	23,855	68.4	67.9
51S-T	46,515	30,415	65.4	91.6
25S-O	25,115	15,845	63.1	42.4
25S-W	49,145	27,595	56.1	80.9
25S-T	57,950	34,255	59.2	95.3
17S-O	29,310	17,630	60.2	49.5
17S-T	60,700	33,100	54.5	97.2
C17S-T	66,250	34,865	52.7	115.9

Machinery

*Manufacturer's designation for kind and temper of material tested.
†Each shear strength value is an average of twenty-four specimens of different thicknesses blanked with dies having different clearances.

Table 3. Angles at which Shear Cracks Start in Blanking Aluminum

Material Tested*	Angle of Shear Crack		Material Tested	Angle of Shear Crack	
	Deg.	Min.		Deg.	Min.
2SO	7	30	51S-W	6	25
2S4	6	50	51S-T	6	00
2SH	6	40	25S-O	6	20
3SO	8	00	25S-W	6	15
3S4	5	00	25S-T	6	10
3SH	4	45	17S-O	6	55
51S-O	8	15	17S-T	6	00

Machinery

*Manufacturer's designation for kind and temper of material tested.

In computing the shearing strength values, the mean diameter of the blank was taken in calculating the circumference. The circumference was multiplied by the thickness of the sheet to obtain the area of the metal in shear. It was found that the loads varied only slightly for the different clearances between the punch and die. The shearing strength was, therefore, computed for all the specimens, and the average taken.

Direction of Shearing Cracks

An attempt was made to determine the angle that the cracks made with the normal perpendicular to the surface of the metal sheet when shearing started to take place. Using a sample of 2SO sheet, pressure was applied until a maximum load was reached, at which point the blanking operation was started, but only about 25 per cent completed. The specimen was then sectioned and examined for shear cracks with a microscope by the metallurgical division. No cracks were visible.

Other specimens were submitted at a later date, but instead of making a partially blanked specimen for examination, specimens were made from plate 1/4 inch thick from which blanks had been punched using a punch and die having a clearance of 6.2 per cent of the thickness of the metal.

Table 3 gives the angles made by the cracks with the normal perpendicular to the surface on the 1/4-inch blanked disks. No doubt the angles at which the shear cracks start are much greater than the angles measured, yet no accurate determination could be made.

Conclusions Drawn from an Analysis of the Tests

From the results of this investigation the following conclusions seem warranted:

1. There is a definite ratio between the proper clearance between the die and shearing tool and the thickness of the metal sheared. Also, this ratio varies between the values of 0.10 to 0.16, depending upon the kind and temper of the metal.

2. The maximum clearance is less for annealed metal than it is for hard metal in the case of cold-worked material.

3. For heat-treated metal the opposite appears to be true; that is, the maximum clearance for heat-treated metal is less than it is for the same metal in the annealed condition.

4. An average ratio of 0.14 can be used in nearly all cases with quite satisfactory results, regardless of the kind and temper of the aluminum or aluminum alloy sheared.

5. The shearing strength of the metal varies from about 52 to 72 per cent of the tensile strength of the metal, depending upon the kind and temper. The annealed metals have the higher percentage, while the cold-worked and heat-treated metals have the lower percentage.

6. The shear strength values as determined by blanking disks agree quite closely with the shear values obtained from other shear tests where a specimen was tested in double shear.

7. The angle of the edges or sheared surfaces of the blanks varies from 4 3/4 degrees to 8 1/4 degrees with the normal, depending upon the kind and temper of the metal. The greater angles are for the soft and annealed metals, while the smaller angles appear in the cold-worked and heat-treated metals.

* * *

WORLD'S AUTOMOBILE OUTPUT

According to a survey made by the Automotive Division of the Department of Commerce, the world's output of automobiles during 1928 exceeded that of the preceding year by more than 1,000,000. Of the 5,200,000 motor vehicles produced last year, 88.4 per cent were manufactured in the United States and Canada. It is stated that 55 per cent of the total production was for replacements, as compared with approximately 50 per cent in 1927, 37 per cent in 1926, and 37 per cent in 1925.

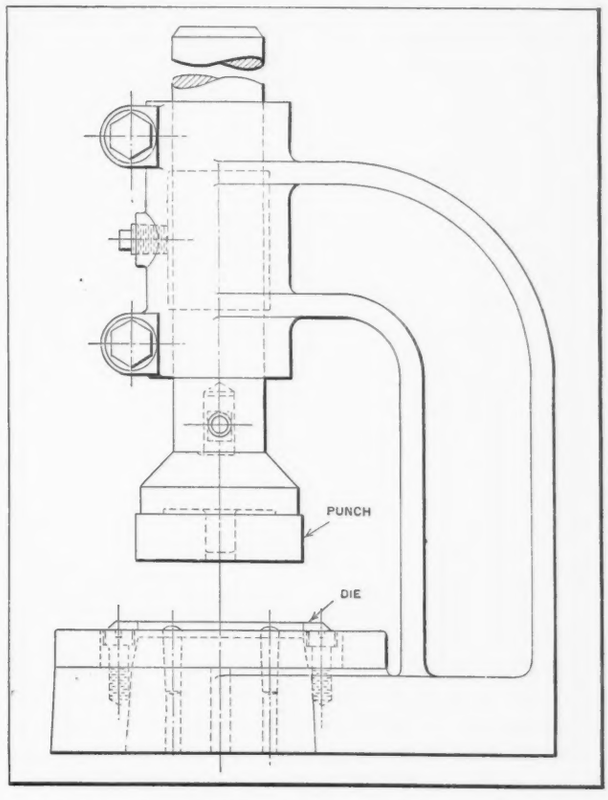


Fig. 11. Special Blanking Die Used in Producing the Sheared Blanks Illustrated in Figs. 1 to 6

Records that Help to Reduce Accidents

By Recording Accidents Employers are Kept Informed Concerning Avoidable Injuries, and Employes Become More Careful

By A. H. RODRICK

A GREAT industrial waste—perhaps the greatest single waste—is due to preventable accidents. During the year 1925 there were 10,537 fatal and 1,687,957 non-fatal industrial accidents reported in the United States. The New York State Industrial Commission states that 149 workers, including five women, were killed in the course of their employment during April, 1927. Of this number, 105 left as dependents 87 widows, 115 children, and 17 parents. Fatal accidents in this one month thus completely altered the lives of 368 individuals in the state of New York alone. Such figures tend to justify the claim that the problem of industrial safety cannot be overemphasized.

The economic side is equally important. In a recent address, Herbert W. Heinrich of the Travelers Insurance Co., stated that an analysis of 5000 accident reports, drawn at random from the files, showed that the incidental cost of accidents borne by employers directly, was four times the total cost represented by compensation and liability claims and medical treatment.

This problem has not been given the attention that it deserves because so many fail to realize the toll that accidents exact. However, in recent years, the installation of safety devices and the circulation of safety literature have done much to prevent industrial accidents. Another method of reducing accidents of this class is to keep a record of all injuries as they occur. This article describes a simple system developed for this purpose.

Every Accident Should be Recorded no Matter How Trivial

Industrial plants should have a regulation requiring employes to report all injuries, no matter how slight. A mere flesh wound, if not treated promptly, may cause loss of productive hours to the employer and loss of wages to the employe. Thus in reporting what may seem trivial accidents, employers and employes have a mutual interest.

Unless all injuries are reported, the management cannot analyze conditions properly nor will it be in a position to take the necessary steps to prevent the recurrence of similar accidents. Under slightly different circumstances, trivial accidents might be serious. For example, a flying metal chip might inflict a slight wound if it struck a workman's hand, but if it struck his eye, it might blind him.

What Constitutes an Accident?

Workmen, as a rule, are inclined to consider an accident or injury as such only when it is serious or when attended by pain or loss of blood. They should, therefore, be instructed that anything occurring unexpectedly outside of the regular routine is an accident, and that if any part of the human body becomes affected as the result of such an occurrence, it is an injury. They should understand that all accidents do not result in injuries and that all injuries do not cause loss of time.

Occupation	Average Number on Rolls	Hours Worked	Number of Accidents	Accidents per Million Hours Worked	Number of Lost-Time Accidents	Lost-Time Accidents per Million Hours Worked	Number of Days Lost by Accidents	Days Lost per Thousand Hours Worked	Loss in Wages
Blacksmiths									
Boilermakers									
Buffers & Polishers									
Chauffeurs									
Clerks									
Coppersmiths									
Cranemen									
Draftsmen									
Electricians									

Fig. 1. Form for Recording Details Relating to Accidents and Time Lost

It has been well said that one of the principal sources of accidents is the worker himself. Hence, the first step to take in carrying out a successful safety program is to secure the cooperation of the employes. This can best be accomplished by showing them what accidents have happened and what may happen. In order to do this, a record must be kept of all injuries.

Accident Records Should Constitute a Complete Analysis

The accidents recorded should preferably be classified in two ways: First, according to the number, loss in time, and loss in wages; and, second, according to the causes. In Fig. 1 is shown a form that provides a convenient means of recording the essential facts for each current month. Each occupation may be listed on such a record or only major ones. If the latter plan is followed, a single group can include all allied trades and occupations. For instance, under "machinists" would be included

toolmakers, machine operators, etc., and even supervisors and helpers. The listing of every occupation is better suited to the small factory, while the listing of major occupations requires less computing in large establishments. Where campaigns have been inaugurated for the prevention of accidents, individual reports can also be prepared for various shops, departments, or divisions. Much good has been accomplished by means of local shop competitions and the use of catchy slogans.

The listing on accident records of the number of hours worked by employes serves a dual purpose. It not only provides a means of computing accident rates, but also informs the management of the actual number of productive hours in a given month, together with the number of hours lost as the result of accidents. The loss in productive hours is sometimes a definite expense, but not always. There are indeterminate incidental losses which the employer cannot cover by insurance policies, such as the shutting down of a machine or the transfer of a less experienced workman, with resultant decreased production, and often spoiled work.

The computation of accidents in terms of million hours of work is in accordance with the recommended practice of the United States Bureau of Labor. Where the employes are few, the accidents may be given per thousand hours worked. The "severity rate" may be expressed in either days or hours lost, although an injury causing no loss of time other than the remainder of a day or shift need not be classed as a lost-time accident, unless the employer desires to have a record of every productive hour lost through this cause. In this event, it is better to keep the record in hours rather than in days.

Causes	Classifications				
	Safety Lacking	Failure of Employes	Unsafe Practices	Unavoidable	Total
I-105	2	4	6		12
111	1	5	8	1	15
115	4	10	9		23
119		7	4		11
120	1	2	4		7
121	7	13	5		25
123		6			6
125	3	7	7		17
III-A-2	4	3	7		14
B-6	2	7	1	2	12

Fig. 2. Form for Listing Accident Causes and Classifications

Classifying the Cause of Accidents

It is not always possible to determine the primary cause of an accident, but the immediate cause can always be definitely ascertained. Fig. 2 shows a simple form which may be used for recording the causes and classifications of accidents. The various causes to which industrial accidents may be attributed are listed in Bulletin 276 of the United States Bureau of Labor Statistics, covering practically every class and kind of industry. This publication will be helpful to those interested in accident prevention.

In this bulletin the general cause classification consists of eleven major divisions, as follows: (1) Machinery. (2) Vehicles (not including construction of). (3) Explosions, electricity, fires, and hot substances. (4) Poisonous and corrosive substances and occupational diseases. (5) Falls of persons. (6) Stepping on or striking against objects. (7) Falling objects (not being handled by injured). (8) The handling of objects. (9) Hand tools. (10) Animals. (11) Miscellaneous causes. The general causes are further subdivided into various secondary causes. For example, if a workman is injured at a drilling machine, the cause of the accident would be recorded as I-115, "I" representing drilling machines, either radial or upright.

When an accident has occurred at a machine, the first question asked is whether the machine was equipped with a safety device, and, if not, whether one could have been installed. If no such device was provided where it was possible to do so, the accident should be classified under "Safety Lacking" in Fig. 2. The same classification should be made for any accident due to lack of safeguards, whether it happened at a machine or not.

Accidents occurring because of employes failing to use safeguards provided by the employer should be classified under "Failure of Employes" in Fig. 2. Typical accidents of this class occur at grinding machines as the result of workmen failing to use goggles. As another example, if a workman injures his hand in using a file without a handle when an order has been issued forbidding such use of files, the workman should be considered responsible for the accident.

If a machine or dangerous place cannot be guarded and a workman is injured because he did not exercise the proper care in working around such places, the accident should also be classed under "Failure of Employes." In such a case, an employer has done all that is possible to protect the workman. If an accident under such conditions is caused by the failure of a fellow workman, the classification should be the same.

Under the classification "Unsafe Practices" on the form in Fig. 2 should be recorded all accidents caused by those practices in which careless, frivolous, and thoughtless employes so often indulge. Such accidents should always be investigated and the men responsible for them dealt with accordingly.

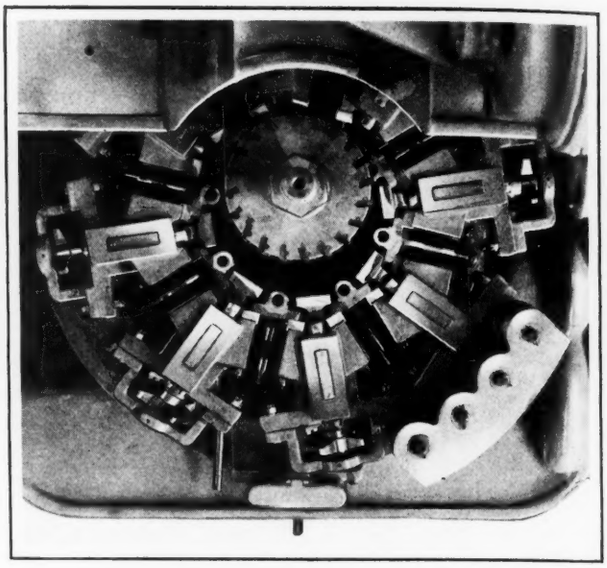
Under the classification "Unavoidable" come those accidents that cannot be prevented even by the vigilance of the employer or the carefulness of the employe. There should be few accidents of this class, and none should be so classified until a thorough investigation of the circumstances has been made.

In conclusion, it is well to emphasize the facts that great savings can be effected by preventing industrial accidents, that loss of productive hours represent a loss of money, that preventable accidents are the most costly because they occur oftenest, and that the incidental expense of accidents is far greater than is commonly believed.

Milling Automobile Steering Knuckles

Methods Employed in Leading Automobile Plants for Finishing the King-pin Bosses on Steering Knuckles of Different Types

By CHARLES D. OESTERLEIN, Vice-president and General Manager, Oesterlein Machine Co.



WHAT is the best method of handling automobile steering knuckles through the production line? This problem has been worked out by many production executives in various ways, and it is one on which differences of opinion still exist. Not that experience with steering knuckles has been lacking, but with the application of four-wheel brakes, the construction of these parts was changed and new practices had to be developed.

In visiting a number of automobile plants while they were developing present practice, the writer found widely different ideas as to how steering knuckles should be routed and how certain operations should be performed. Some of these methods had to be altered later because of difficulties encountered in carrying them out, although on paper they seemed practical and economical.

Routing Followed in Some Plants

The shape and dimensions of the steering knuckles have some bearing on the order of operations. This accounts in a measure for the differences that exist in practice. The following order of operations is followed by a number of the largest automobile manufacturing plants: Straighten; center; turn spindle; rough-grind spindle; rough-mill king-pin bosses; drill and ream king-pin holes; finish-mill king-pin bosses; and finish-grind spindle. Other manufacturers, however, follow considerably different schedules.

Under any circumstances, when it comes to the operation of milling the king-pin bosses, certain factors are involved that deserve serious consideration. When it is not important to hold to a small radius at the bottom of the cut, and a large radius is permissible, the "offset" milling process is advantageous. By this method, in which an Oesterlein tilted offset miller is employed, a number of parts may be kept under the cut all the time, thereby maintaining a practically uniform peak load on the machine.

The important principle of this process may be understood from the heading illustration, which shows an operation being performed in a 48-inch machine of the type mentioned. The photograph was taken from directly above the machine, with the outboard bearing and cutter guard removed. A big advantage of the offset process, in addition to that already mentioned, lies in the manner of presenting the work to the cutter. With the manner employed, the feed is greatest in the early stages of the cut and is gradually reduced until, at the bottom of the cut, where the arcs described by the work and cutter become tangent, it fades to nothing, after which the parts recede on the other side of the cutter.

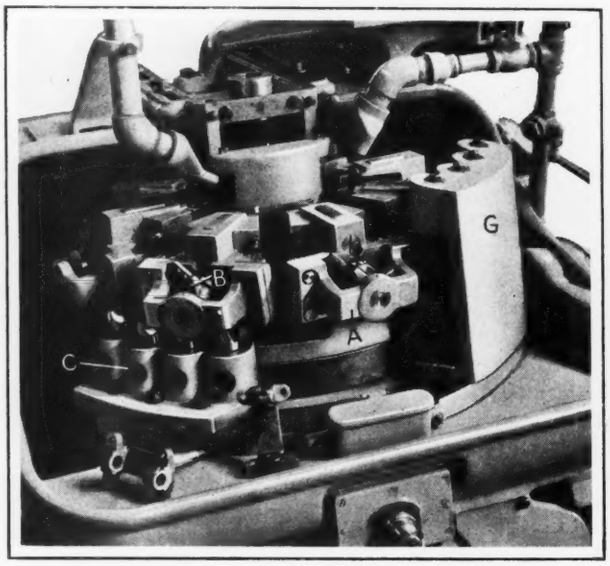


Fig. 1. Another View of the Operation Shown in the Heading Illustration, Taken from the Front

In some cases, however, it is important to hold to a small radius at the bottom of the cut, so as not to weaken the section that ties the king-pin bosses together. This makes it necessary to use a "plunge-cut" milling operation, with relatively small cutters. It is also desirable that the feed be materially re-

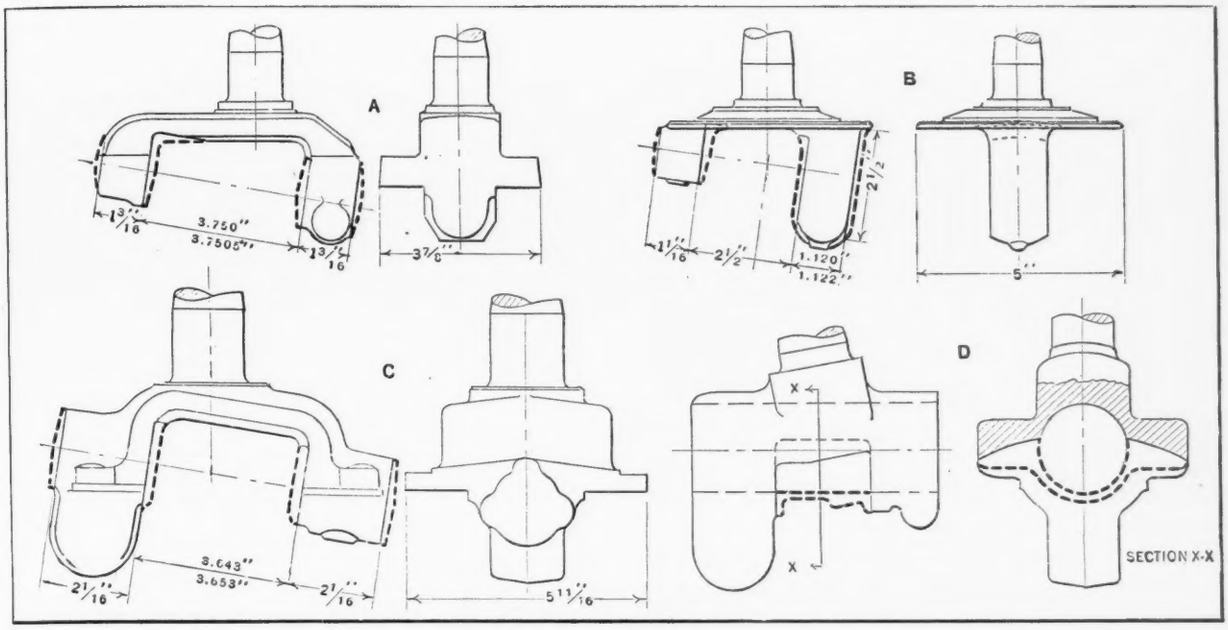


Fig. 2. Various Types of Automobile Steering Knuckles Machined by Methods here Described

duced at the bottom of the cut from what may be economically used when passing over the faces of the bosses only. This is obvious, because as the cut becomes deeper, more metal is removed and the load becomes greater.

Figs. 6 and 7 show the tooling employed in milling several steering knuckles of this class on 40-inch heavy-duty Ohio tilted rotary millers. Machines of this type are designed to feed the cutters into the work by means of a cam. The rise of this cam may be tapered off on the high end to provide a feed as low as 1/2 inch per minute, or even less, at the bottom of the cut.

Finishing Steering Knuckle Bosses by Offset Milling

The operation shown in the heading illustration and in Fig. 1 is performed on the steering knuckle shown at *A*, Fig. 2. It follows all other roughing operations, including drilling. Approximately 1/4 inch of metal is removed from the outside face of each boss, and approximately 3/16 inch from the inside, as indicated by the heavy dotted lines. The steering knuckles are milled at the rate of 160 per hour. The cutters average 1600 pieces per grind, although in some set-ups, over 3000 pieces are produced per grind.

The forgings are mounted in an eight-unit fixture, designed for use in connection with four 10-inch side milling cutters. The end of the steering knuckles to be milled extends toward the inside of the fixture and, consequently, toward the cutters. The spindle of each steering knuckle is supported in hardened V-blocks and a pair of hardened jaws, being held in place by an equalizing clamp. The clamping mechanism is illustrated diagrammatically in Fig. 3.

The steering knuckles are loaded into the fixture at the point indicated by *A* in Fig. 1. Then, as star-wheel *B* comes in contact with the four plungers held in bracket *C*, the star-wheel is revolved, pulling forward the threaded spindle *D*, Fig. 3, and pin *E* with it. This movement actuates jaws *F* and causes them to clamp the steering knuckle spindle after they are positioned in the V-blocks, as explained. At the end of the operation, the clamping mechanism is opened as the star-wheel is revolved in the opposite direction when it is carried beneath the four plungers held in bracket *G*, Fig. 1.

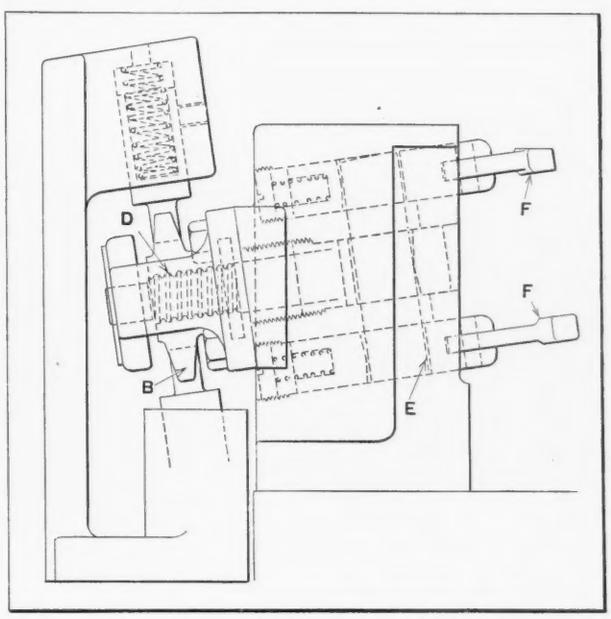


Fig. 3. Plan View of Mechanism for Automatically Clamping the Work in the Fixture

Fig. 4 shows the equipment used for milling the king-pin bosses of Nash steering knuckles. The offset milling process is employed in this case also. The rough-milling operation on these surfaces is the first machining operation after the forgings are straightened. In this operation, the forgings are also mounted in an eight-unit fixture designed along sim-

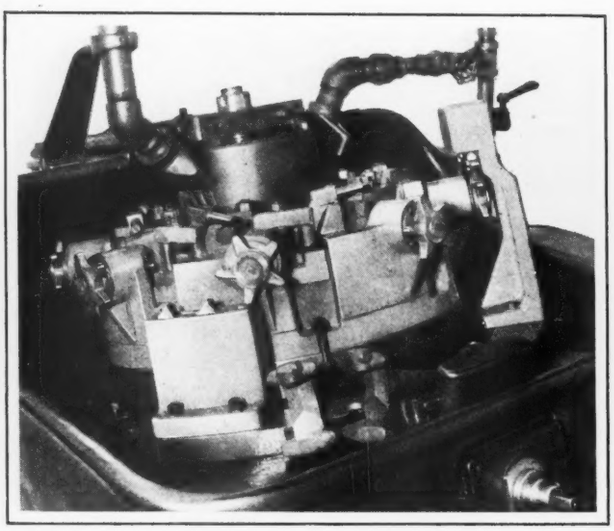


Fig. 4. Set-up for Machining the King-pin Bosses of Nash Steering Knuckles

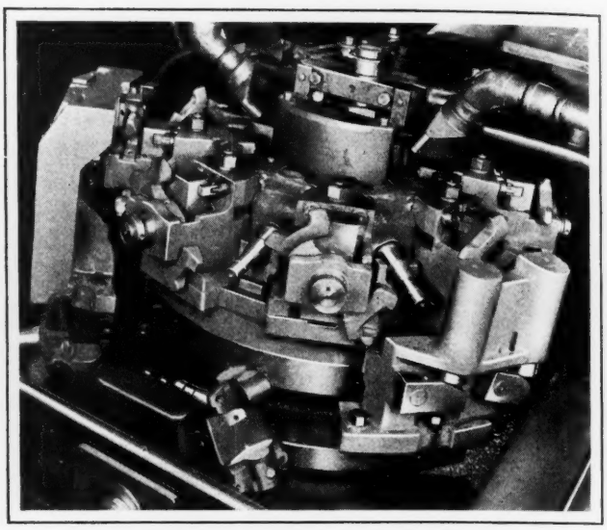


Fig. 5. Milling the Heavy Type Steering Knuckle Shown at C, Fig. 2

ilar lines to that shown in Fig. 1. Four 10-inch side milling cutters are employed and the work is held the same as in the preceding case. The steering knuckles are squared radially in the fixture units by stops that take the pressure of the cut when the automatic clamps operate.

From 1/8 to 3/16 inch of metal is removed from each of the king-pin boss faces, and one cutter removes approximately 1/4 inch of stock in the corner at the bottom of the cut, for clearance. These steering knuckles are milled at the rate of 140 pieces per hour.

Fig. 5 shows the equipment used for milling the heavier steering spindle *C*, Fig. 2. The rough-milling operation, in this instance, is performed before the king-pin holes are drilled, but after all other roughing operations. For milling the king-pin bosses, as illustrated, the steering knuckles are mounted between pairs of hardened jaws, one of which has a pin for locating the part in the proper position vertically, so that the milling will be in line with the steering spindle. The front faces of the lugs on the king-pin bosses are used for locating purposes. It will be noted that the spindle of each steering knuckle is placed in a fork which, in addition to supporting the spindle, acts as a gage for checking previous operations.

On these steering knuckles, the average amount of metal removed per side from each boss is approximately 3/16 inch, the bosses measuring about 2 inches across their faces. The steering knuckles weigh 15 1/2 pounds each, and are rough-milled at the rate of 85 parts per hour, which represents an increase of 286 per cent over former production figures. Again, all clamping and unclamping of the parts is performed automatically, the operator only having to keep the fixture loaded.

Machining Steering Knuckles in Tilted Rotary Milling Machines

The steering knuckle shown at *B*, Fig. 2, is machined in accordance with the order of operations outlined at the beginning of this article, and comes to the Ohio tilted rotary miller shown in Fig. 6 with the spindle rough-ground. By comparing Fig. 6 with Fig. 4, it will be seen that whether the spindle is rough or finished prior to this operation, the same general method of locating the part can be em-

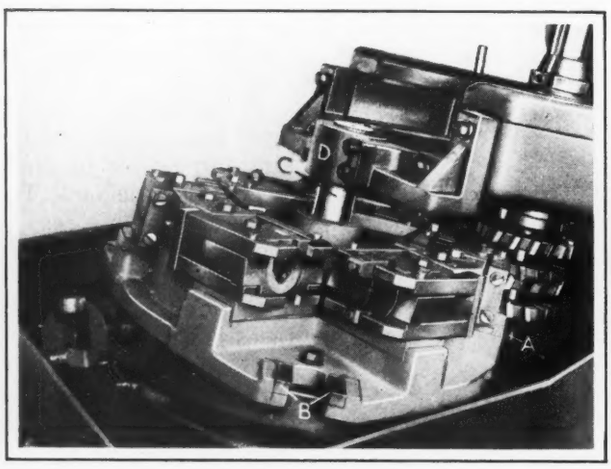


Fig. 6. Finishing Steering Knuckles by "Plunge-cut" Milling

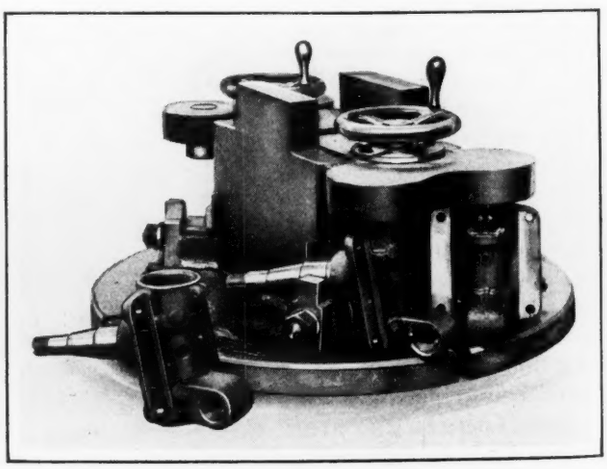


Fig. 7. Fixture for Milling Overland Closed-type Steering Knuckle

ployed. In the operation shown in Fig. 6, the spindle is also laid in V-blocks, a hinge clamp is placed over it to hold it down, one fixed jaw is used for gripping a king-pin boss to locate the part radially, and equalizing clamping jaws pull the steering knuckle back into the socket formed by the V-block and other jaws.

Four inserted-tooth cutters, 9 inches in diameter, are used in this operation. They are fed at the rate of 6 inches per minute until they reach the bottom of the cut, when the feed is reduced to 3/8 inch per minute for removing the last 1/4 inch of stock. The production averages 120 steering knuckles per hour.

For steadying the cut, a roller provided on the lower end of the cutter-arbor, as shown at *A*, Fig. 6, fits into the roller guide blocks *B* directly beneath each two parts being machined simultaneously. Also, the fixture has an outboard support *C* which fits into the overhead bracket *D* that ties the two arms of the housing together. This construction interlocks all machine members subjected to the strain of the cut.

The work-holding fixture employed in milling Overland steering knuckles as a last machining operation after the king-pin holes and the spindle have been finished is illustrated in Fig. 7. The knuckle portion of these forgings is completely closed when the forgings come to the milling machine, which facilitates the accurate machining of the king-pin holes. This enclosing metal between the king-pin bosses is removed in a tilted rotary miller, and the solid metal on the sides of the forging is also cut into quite deeply so as to afford clearance for the axle.

Each steering knuckle is located from the king-pin hole by an overhead plug which is lowered into the reamed hole. The steering knuckles are held in the proper radial relation to the cutter by a clamp which pushes the spindle against an adjustable screw. As the cutters become smaller from resharpening, adjustments can be made to bring the center lines of the steering knuckle spindles into line with the center of the cutter in its foremost position. On one size of steering knuckle, the production averages 65 parts per hour, and on a smaller size, 75 parts per hour.

* * *

The formation of ice and slush at the inlet of a submerged power pipe line at one of the municipal hydro-electric plants in Seattle, Wash., is prevented by the aid of compressed air. The air is forced up through the water around the pipe inlet, its action melting the ice and also keeping any trash away. According to *Compressed Air*, ice as thick as 10 inches has been effectively melted by this method.

Tooling Up for New Work

Some of the most serious problems of the production manager are presented to him when it becomes necessary to tool up for new work. The article "Planning and Tooling up for New Work" to appear in October MACHINERY briefly describes a simple system that may be used to advantage in either large or small plants. This system has been developed with the view of eliminating production delays due to overlooking some of the apparently small details that become important when beginning the manufacture of a new product. Men who have to do with planning and tooling for production work will be interested in studying the system outlined.

PLACING THE ENGINEERING GRADUATE

The Iowa State College, Ames, Iowa, has inaugurated a rather unique method of placing industry in touch with the engineering graduates of the college. Every year many large industrial organizations are confronted with the problem of selecting engineering graduates who have the proper qualifications for their particular organization. Many companies send representatives to visit the engineering colleges and arrange for personal interviews with the prospects, while others encourage the student to send them a statement of his experience, training, and qualifications. Only the very large companies can afford to send representatives to interview the graduates, and the statement sent by the student himself may not always be as complete or informative as may be desired.

For this reason the personnel office of the Engineering School of the Iowa State College has devised a personnel service leaflet. This leaflet is a single sheet, 3 3/4 by 6 3/4 inches in size, punched to fit a standard loose-leaf binder. On this leaflet is printed the name of the student, together with a halftone photograph; then briefly, the following information is given: Course, date of graduation, major interests shown by student, college and home address, age, height, weight, nationality descent, and religion. The information further mentions the activities in which the student has engaged during his college years, the engineering or technical societies and other organizations to which he has belonged, and lists his practical experience previous to entering college and during the summer vacations.

Sets of these leaflets are sent to the leading industrial organizations in the country early in January each year, bound in a loose-leaf cover furnished by the college. Frank D. Paine is in charge of the personnel work of the Engineering Division of the Iowa State College.

* * *

CHEMICAL COOLING OF AIRCRAFT MOTORS

The chemical cooling of aircraft motors, as recently described in *Mechanical Engineering*, is accomplished by means of ethylene glycol, which is a clear, colorless, odorless fluid boiling at 387 degrees F. In structure and characteristics, this fluid resembles ethyl alcohol and glycerol, and occupies an intermediate position between the two. It is not a newly discovered liquid, having been on the market for some time, but its use in connection with high-temperature cooling is claimed to be a new development. The use of ethylene glycol enables a radiator about one-quarter the size ordinarily used to be employed.

What MACHINERY'S Readers Think

A Department for the Interchange of Ideas on Problems of Management, Foremanship, and Employe Relations

PAYING FOR SPECIAL MACHINE COLORS

The writer has noted with interest the proposal of the National Machine Tool Builders' Association to establish a standard color for machine tools. Presumably, if the customer wishes a color other than that adopted as standard, he will be expected to pay for the additional cost of painting the machine according to his specifications. This seems reasonable, because it is evident that painting the machine a special color will add extra costs, as compared with finishing the machine in a standard color.

The machine tool builder could, of course, set the price of his machine high enough so that it would cover the extra cost of special finishes when asked for, but this is not a satisfactory method and is not to be recommended. It is proper that each buyer should pay for anything that is specially done for him, and quotations ought to be made in such a way that it becomes evident that the buyer is paying for having a machine painted in other than the standard color. This will tend to make the standard color more generally accepted.

A. DAVIDSON

INFORMATION FOR INSTALLING MACHINERY

Users of machines are complaining that many machine builders fail to supply adequate information as to floor space, depth of foundation required, and other details needed by the purchaser. Lay-out plans that show sufficient details to enable the millwright to arrange for foundations, locate the machine correctly, and place the driving pulleys, if any, should be available.

Information of this kind is important in laying out a new department or installing new machinery in one that is already established. A lay-out diagram, together with the necessary information, should be furnished to the machine user by the builder at the time the purchase is made. Unnecessary delay in securing the required information will thus be avoided. ARTHUR FRUNCILLO

[The National Machine Tool Builders' Association has adopted a standard data sheet that gives the information referred to above. Similar data sheets could be used by manufacturers of other types of machines.—EDITOR]

SHAFTS ARE MOUNTED "IN" NOT "ON" BALL BEARINGS

Descriptive articles and advertising literature relating to machinery frequently contain such expressions as "The spindle is mounted on radial ball bearings." To the writer, this appears incorrect, because a spindle or shaft is always in the center of the ball bearing races, and these races completely enclose the spindle. Therefore, spindles are mounted "in" and not "on" radial ball bearings or roller bearings. No one would think of saying that a shaft runs "on" bronze bushings, and yet it would be just as logical to use this expression in connection with bronze bushings as with ball and roller bearings.

In the case of vertical shafts or spindles resting on ball bearings intended to take the vertical thrust, it is obviously correct to say that the spindle runs or is mounted "on" ball thrust bearings.

OLIVER HERBERT

HELPING EMPLOYES TO OBEY SHOP RULES

The employe who is habitually late or who is deficient in living up to other requirements of an organization need not necessarily be dropped from the payroll. If he has been hired by an employment department that functions properly, he must have some characteristics that are worthy of development. If, after proper effort, it seems to be impossible to correct the undesirable traits, it is best to have a plain talk with him, pointing out the fact that such habits are detrimental to departmental discipline and explain to him that unless he is willing to cooperate, it will be impossible to keep him.

In this talk it may be possible, by approaching the subject tactfully, to find out the real cause of the trouble. Many of the traits that are so difficult to correct are the result of careless home training; for example, the man has not been taught, as a child, order, neatness, or the proper recognition of time. Frequently, valuable people are lost to an organization because of the difficulty of overcoming these defects, and while it is not always possible to correct them without great effort on the part of executives and co-workers, where other qualities warrant the trouble, it often pays. JOSEPH BELL

CHANGES IN ENGINEERING STANDARDS

I regard the article "Changes in Engineering Standards" on page 757 of June MACHINERY as a very able analysis of the problem. The change that represents development, improvement, and progress is an indication of growth, and must always be fostered in a logical way, to assure the success of real standardization. On the contrary, changes that are occasioned by inadequate consideration in the adoption of the standard must be eliminated.

A long and intimate contact with Army-Navy Aeronautical Standards has shown that these detri-

mental changes may usually be traced to the following causes:

A — *Inadequate Publicity before Adoption* — Proper publicity involves not only wide distribution of notices of contemplated standard activity, but the distribution of detailed agenda, well in advance of standardization conferences, so that pertinent investigations may be made by the organizations participating. Lacking this, standards hastily adopted may be changed upon later investigation.

B—*Lack of Cooperation of Correlated Industries* —The standardization of a product used by the standardizing industry and made for it by another industry, or which involves another industry by virtue of its materials, processes, tolerances, or equipment, must have the full cooperation of that correlated industry. Failure to observe this rule is probably the most prolific source of changes. The basic correlated industry can often prevent the adoption of similar but not fully coordinated standards by two consuming industries, such as automobile and aircraft, by acquainting one industry with the standards of the other.

C—*Too Detailed Standardization*—Proper standardization should not extend beyond the needs of full interchangeability, or it will be unnecessarily restrictive.

D—*Lack of Recognition of Cost as a Factor*— Many unnecessary changes are brought about because at the initial standardization conference the only consideration is engineering utility. Later developments show that a similar product, slightly less perfect technically, but entirely adequate, can be made at less cost, and the standard is not used, and so is changed. If cost is a consideration in all standardization activity, this can be avoided.

JOHN F. HARDECKER

TRAINING SUPERVISORS

Enthusiasm, keen interest, and highly satisfactory results were reported by one company which, some time ago, inaugurated a plan for training shop foremen and other supervisors. About twenty-five men responded to a call from the president's office to start the course, which comprised modern production methods and factory problems that had arisen, and were likely to arise, in the plant.

The class met every second week, after hours, in the plant. Each meeting consisted of a lecture by an experienced man, with the faculty of telling clearly many items of interest that could be applied directly by the men. A round-table discussion of the lecture followed, and the meetings did not end until every man present admitted that there were no points not entirely clear to him. As the chief executives of the plant were members of the class, it was always certain that the policies of the management would be correctly interpreted to the foremen.

The subjects covered in the training plan were how to promote teamwork in the shop, handling workers by methods that make for harmony and efficiency, improved methods of factory organization, handling materials and equipment, reducing costs and stopping leaks, and modern ideas of management generally. The course was conducted under the direction of an outside concern which supplied the text material and the lectures. It was not too technical, but dealt with basic facts and principles and was easily understood by the men attending classes.

E. ACKERMAN

OVER-EMPHASIZING SAFETY

The writer believes that safety can be overemphasized and that too many safety signs may have an effect exactly opposite to that desired. For instance, if a great many detailed and specific "don'ts," together with vivid descriptions of the disasters that lie in wait for the unthinking violator, are located all about the shop, men who have been performing certain operations safely for years may become so nervous through fear of making a false move that they will bring upon themselves the accident they are trying to avoid.

In general, the writer does not favor the permanent type of display unless it is merely a slogan such as "safety first." It is better to provide a bulletin board and put up new posters periodically in order to maintain interest in safety work. If an accident occurs through carelessness, the management can readily communicate the true cause to the other workmen far more effectively by word of mouth than by an official notice in the form of a new sign or bulletin.

S. KUPPER

KEEPING SPECIFICATIONS UP TO DATE

In many cases, inadequate or entirely unsuitable specifications are provided in purchasing material. Unless specifications are accurate, commercially practicable, and up to date, they may be responsible for many production difficulties. Some specifications are unsatisfactory simply because they are not given sufficient managerial consideration. In many instances, the preparation of specifications is left to young draftsmen or beginners in the planning department. The job has too often been considered a clerical instead of an engineering one. This is entirely wrong. A faulty specification may waste more money in a week than a good automatic machine can save in a year.

The preparation of even a simple specification may involve quite a little expense if properly done; it certainly is not so simple a matter as writing an order for a new tool. The specification should not be issued either to the shop or to the purchasing department until all available information on the subject has been obtained and been given careful consideration. The annual cost of working to specifications is enormous, and it is one of the duties of the production engineer to reduce this cost to a minimum. Keeping the specifications up to date will promote efficient and economic operation.

HARRY KAUFMAN

Indexing Head for Highly Accurate Spacing

Design of Precision Indexing Head Employed in Making the Accurate Gears and Perforated Disks Required for Television Equipment

By FREEMAN C. DUSTON

IN the early stages of the development of television apparatus in the Bell Telephone Laboratories, New York City, it became evident that exceptionally accurate spacing or indexing operations were necessary in producing the required gears and perforated disks. The most careful manipulation of the indexing heads employed for ordinary work failed to give the necessary accuracy. Imperfections in the operation of the television apparatus, which were readily detected by the eye, resulted from exceedingly small irregularities or errors in spacing. These slight irregularities were due to the accumulative error introduced by minute tooth space errors and eccentricities in gear trains of the ordinary indexing devices.

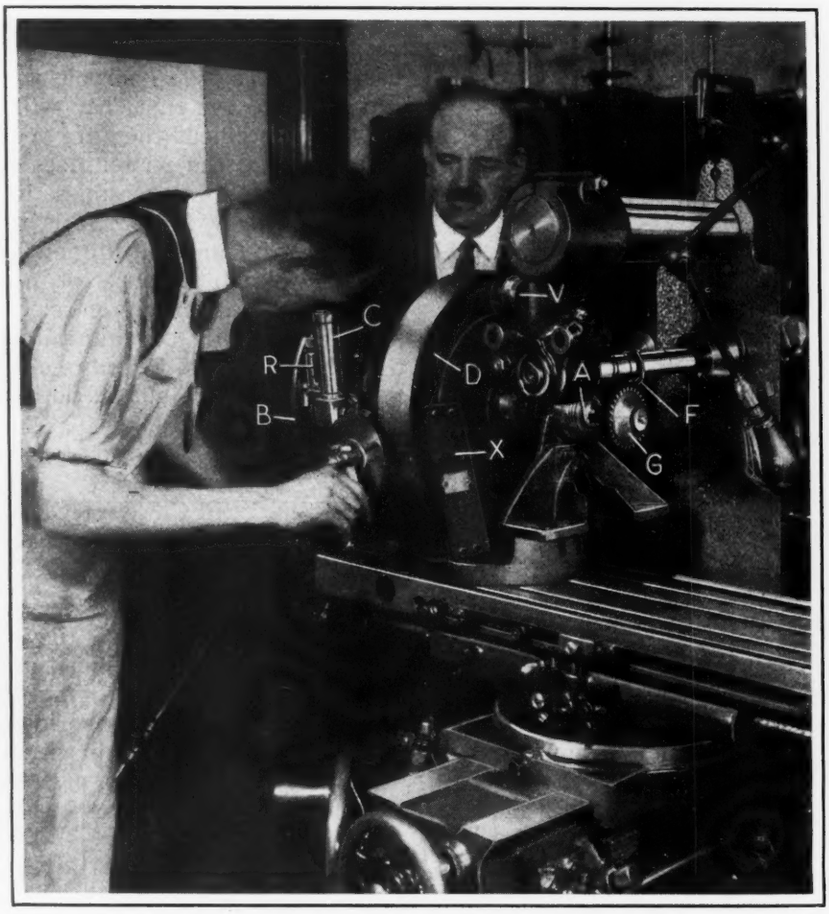


Fig. 1. Cutting Precision Gears in the Laboratory

In order to overcome these difficulties, the precision indexing head shown in the accompanying illustrations was designed and constructed in the laboratory. Although originally built for use in producing parts for television equipment, this indexing head has recently been used successfully for even more exacting precision work on equipment in which both television and sound reproductions are involved. Thus, under skillful handling, the comparatively simple indexing attachment here illustrated performs precision spacing operations of a degree of accuracy ordinarily considered possible only on very expensive dividing engines.

Briefly, the dividing head consists of a spindle *A*, Fig. 1, for holding the work; a graduated indexing disk *B* for obtaining the required spacing; a microscope *C* for reading the vernier scale of the indexing circle; a magnetic clamping device *D* for holding the work-spindle in the indexed positions; and a hand-operated worm meshing with a worm-wheel mounted on the work-spindle.

The spindle *A*, shown also in Fig. 2, is mounted in accurately fitted bronze bushings *E*. The two lock-collars *F*, in conjunction with the collar *G*, provide for the accurate positioning of the spindle with respect to longitudinal movement. The spindle is threaded to take the standard chuck or collet and also has a socket for tapered shank arbors.

Although mounting the indexing plate on the spindle at the work-holding end eliminates many chances for error, its location at this point would, in many cases, interfere with the machining operations. For this reason, the index-plate was located at the rear end of the spindle. In order to obtain the desired accuracy, the indexing circle must be concentric with the center line of the spindle and rotate in a plane at right angles with the axis. On this account, the indexing plate *B* is so mounted at the rear end of the spindle that it can be accurately aligned, both with respect to concentricity and the plane at right angles with the axis of the spindle.

The mounting for the indexing plate consists of the flanged disk *H*, screwed on the end of the taper shank *I*, which is fitted in the socket at the rear

end of spindle *A*; and the flanged arbor *J* on which the disk is mounted. The flange of member *J* is secured to flange *H* by three equally spaced combination screws like the one shown in Fig. 2. The screws *K* of the combination screws are threaded to fit tapped holes in flange *H* and pass through the centers of the screws *L*, which are threaded to fit the tapped holes in flange *J*.

The inner end of screw *L*, when tightened, presses against flange *H*. It is obvious that by properly adjusting these combination screws, disk *B* or its dividing circle *M* can be accurately positioned in a plane at right angles with the axis of the spindle. Adjustment for concentricity is obtained by three equally spaced knurled-head screws *N*.

The combination screws serve to lock the indexing plate in place when the final adjustments have been made. The silver dividing circle *M*, set into the face of plate *B*, has graduations 0.001 inch wide, and is true within 5 seconds of an arc. This circle is similar to those used in astronomical instruments.

Microscope for Precision Indexing

Readings on the vernier scale *O* and circle *M* are made by means of the microscope *C*, which is mounted on a holder that can be adjusted vertically by turning the knurled-head screw *P*. This microscope is of the prism type having the barrel of the eye-piece at right angles to the tube *Q* carrying the optical lens which is focussed on the dividing circle *M*.

The facility with which settings can be made with this equipment will be evident by referring

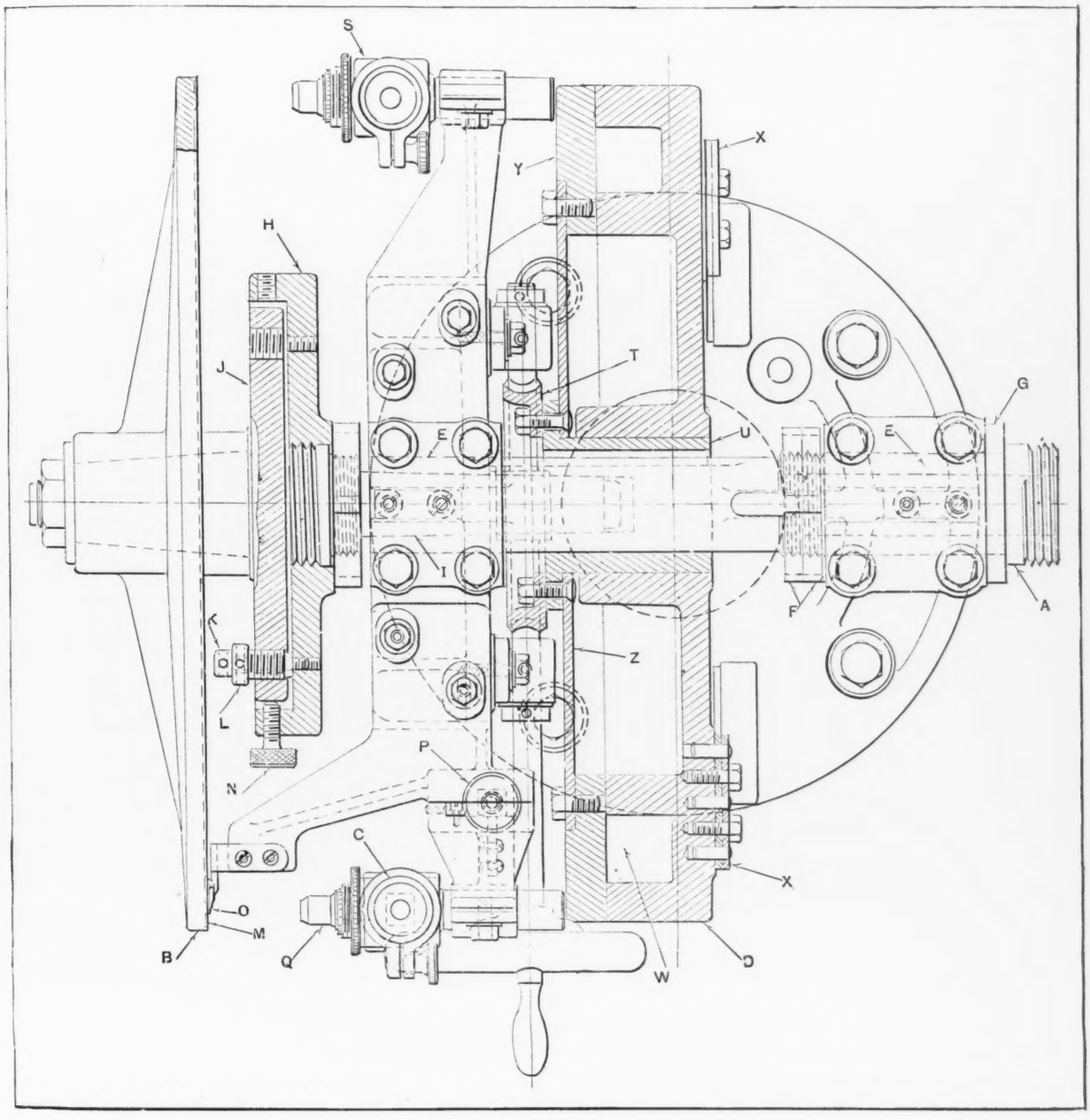


Fig. 2. Details of Precision Indexing Head Assembly Illustrated in Fig. 1

to Fig. 1. At *R* is shown a combination socket and hood which directs the light from a small electric bulb on the vernier scale and dividing circle. At the back of the dividing head is a holder for a second microscope *S*, Fig. 2, the lens barrel of which is in the same horizontal plane as that of microscope *C*. By taking readings with both microscopes before and after revolving the indexing disk through 180 degrees, the adjustment of the microscope and the indexing plate can be checked.

Method of Indexing Spindle

The indexing of the spindle is accomplished by means of a worm and worm-wheel. The familiar indexing plate and crank shown in Fig. 1 have been substituted for the plain handwheel shown in Fig. 2. The worm-wheel *T* is secured to the bushing *U*, which, in turn, is keyed to spindle *A*.

After the spindle has been indexed the required number of degrees, it is locked in position by an electromagnet indicated at *D*. The object in employing an electromagnet for this purpose is to provide a means for locking the spindle that will not impose any distorting stresses on the mechanism. Incidentally, the switch shown at *V*, Fig. 1, provides a convenient means for controlling the spindle locking device.

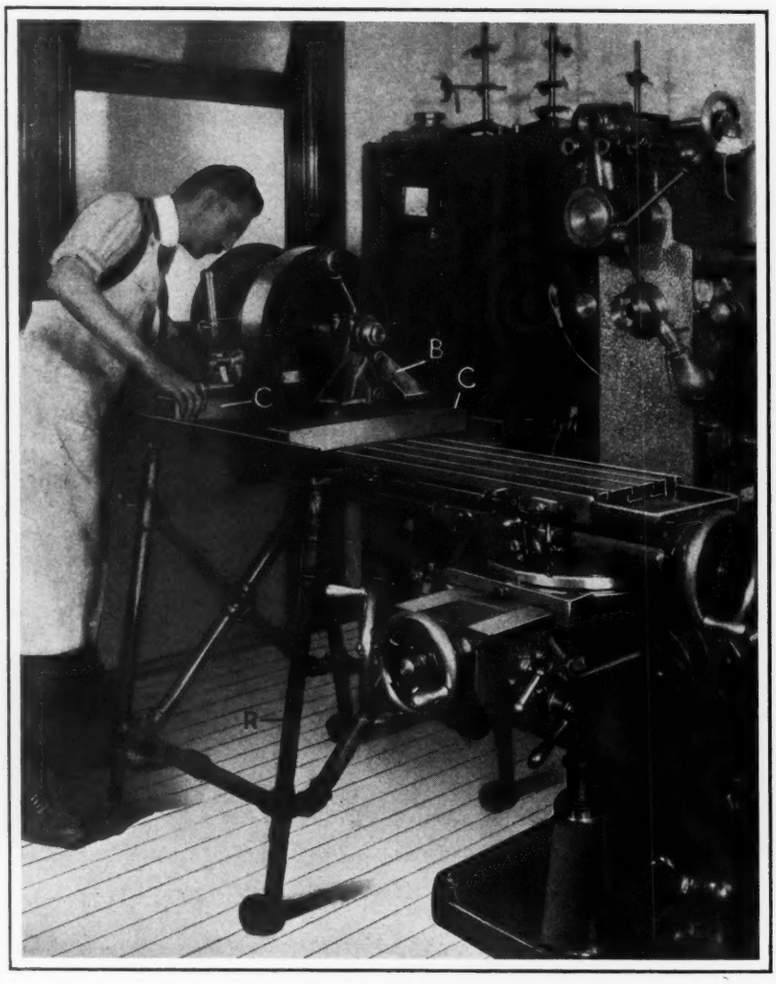


Fig. 3. Transferring Indexing Head from Milling Machine to Supporting Stand

The winding of the electromagnet *D* is contained in the annular recess or groove *W*, Fig. 2. The body or core of the electromagnet is secured to the base of the head by flexible steel straps *X*, and the hole through the hub is a sliding fit on the bushing *U*. This prevents any longitudinal stresses from being imposed on the spindle through the action of the electromagnet.

The ring *Y* on which the magnetic force acts is secured to bushing *U*, which is keyed to shaft *A*, by a flexible disk *Z*. Thus, any movement that might be imparted to ring *Y* by the locking or unlocking action of the electromagnet will not affect the spindle. An essential feature (not shown in Fig. 2) is the provision of a non-magnetic washer between the adjacent faces of members *D* and *Y* to prevent "freezing."

Operation of Dividing Head

In order to obtain the high degree of accuracy required for much of the work performed on this indexing head, it is necessary to give careful attention to many details. The adjustment and setting of the machine and the dividing head attachment requires a high degree of skill and familiarity with the equipment. In order to eliminate errors resulting from changes in room temperature, each job is carried through to the finish without interruption.

Fig. 1 shows the set-up used in cutting the teeth of a small gear *G* with a fly cutter *F*. In this case, the cutter is mounted on the regular machine spindle. Much of the light precision work, however, is done with cutters mounted on the spindle of an electric motor-driven attachment.

In order to prevent the dividing head from being damaged or subjected to unnecessary strain when it is removed from the milling machine, the special rack *R* shown in Fig. 3 was provided. This rack can be rolled into the position shown, the cross-pieces *C* put in place, and the table lowered until the dividing head rests solidly on the stand. The bracket *B* is secured to the base of the head simply to provide an adequate supporting surface on the cross-piece *C*. This bracket can, of course, be removed if it is found to interfere with the work when the head is mounted on the milling machine table; otherwise it is allowed to remain in position on the base of the fixture, as shown in Fig. 1. The removal of the indexing head as described, is made possible by mounting it at the extreme end of the table.

Notes and Comment on Engineering Topics

New freight cars installed on American railroads in 1928 had an average capacity of 50 tons, while those scrapped during that year had an average capacity of less than 40 tons.

Soldering metals to porcelain, which hitherto has met with but slight success, can now be done by a process developed in the laboratories of the Westinghouse Electric & Mfg. Co. This process is said to produce a joint that prevents the passage of both liquid and air, is a good conductor, and is stronger than the porcelain itself.

It is estimated that the United States builds about 85 per cent and uses 78 per cent of all the automobiles produced in the world. Other important car producing countries are: Canada, building 3.9 per cent; England, 4.2 per cent; France, 3.8 per cent; Germany, 1.8 per cent; and Italy, 1.0 per cent. All the remaining countries combined account for only 0.6 per cent of the world's output.

Engines of great power are by no means necessary for the operation of flying machines. Light airplanes may be operated with engines having only from 30 to 60 horsepower, and small planes are now available with engines of from 80 to 120 horsepower. Military training planes and commercial passenger type airplanes seem to require from 150 to 250 horsepower for best results, while military planes and many mail planes use single engines up to 600 horsepower, or multiple engines of 150 horsepower each.

An automatic control for regulating the level of liquids in tanks, operating through the use of photo-electric and selenium cells, is now in service at the Billingham Works of the Synthetic Ammonia and Nitrates, Ltd., according to *Compressed Air Magazine*. A glass inspection gage is fitted on a standpipe at the required level, the relay, which is sensitive to light, being illuminated through the gage. In the case of opaque liquids, the light is shut off when the liquid rises, which action operates an alarm signal. With transparent liquids, an opaque float is used to accomplish the same result. This system of control is said to be especially applicable to liquids under high pressure where the usual regulating methods are impracticable.

Theory is method applied to experience. Since the beginning of the laboratory method of deriving scientific laws, nothing has been more rigorous than theory. By mere experience we might come to a conclusion by one observation. But the practical theorist will make hundreds of systematically planned observations before he will risk stating a general law. Theory is the stuff out of which general scientific laws are made, and general laws are to engineering what accounting is to business. It would be hopelessly inefficient to treat every item of business as a separate entity, just as it would be hopelessly inefficient to treat every fact in engineering, derived from experience, individually.

The high-horsepower taxes imposed by most European governments on automobiles have proved to be a distinct disadvantage to the importation of American cars, as they are generally high-powered, and hence, the horsepower tax often becomes prohibitive. At present there is under consideration in Germany the substitution of a gasoline tax for the horsepower taxes. This would be likely to aid American manufacturers, as the gasoline tax would not discriminate against American cars in the same way that the present horsepower taxes do.

The use of non-metallic gears in many mechanisms materially reduces vibration. The effect of a reduction in vibration on the life of any apparatus is naturally very great, and while in some instances the vibration may not, in itself, be very great, it may have a decidedly detrimental effect because of the delicacy of the mechanism. But even in large machines, non-metallic gears are gaining favor. The chief engineer of an automobile truck company justified the expense of a non-metallic timing gear with the statement that by the use of this gear the reduction of vibrations in the motors was sufficient to show a considerable influence on the durability of the motors. This gear established a reputation for long life for the motor in which it was used.

According to a survey, made by the Department of Commerce, on the increase in the volume of manufactured products in the United States, the goods produced by the manufacturing industries, measured by quantity or physical volume, increased 2.6 times between 1899 and 1923. Owing to the rise in prices, the value added by manufacture, which is the total value of the product less the cost of materials, fuel, and purchased electric power, was 5.4 times greater in 1923 than in 1899. At the same time, the increase in the number of wage earners employed in these industries was only about 1.9 times as great, due to the increased use of machinery and the greater efficiency in conducting manufacturing operations. The horsepower used in industrial plants was 3.3 times as great.

Current Editorial Comment

In the Machine-building and Kindred Industries

SELECTING SMALL TOOLS BY TESTS

In order to obtain metal-cutting tools that will give the best results and produce work of the required quality at the lowest cost per piece, several large firms make careful shop tests with tools obtained from a number of different makers. The tools that meet the requirements are generally not the lowest priced; frequently higher-priced tools are eventually the cheapest, because they perform a larger number of operations per tool. The cost of taps and drills, for example, cannot be gaged by their first cost, but by the cost of producing each drilled or tapped hole.

When tools of a certain make have been used in the shop for some time, it is advisable to check up on them again by comparing them with a small quantity of similar tools from other manufacturers, so that the best tools for the work to be performed and the material to be operated on may be determined.

In one plant when the tools supplied by several makers are tested, the manufacturer's name is effaced, so that the make cannot be identified by the foreman or workmen and preconceived opinions as to the quality of different tools will not preclude a fair trial. In large plants it is also well to select at least two different makes for general use, so as to have two sources of supply.

* * *

INEXPERIENCE CAUSES BREAKDOWNS

With the present sturdy construction of machine tools, breakdowns are due, to a very large extent, to ignorance or carelessness on the part of the operator. The production engineer in a large automobile plant states that unskilled labor is responsible for more breakages of machine tool equipment than any other cause. This means that the machine tool builder must, as far as possible, design machines so that they can be operated by men having little mechanical skill or knowledge. The machines must be practically foolproof; they must be built to be abused.

Maintenance costs depend largely on the operator. This was brought out in one mass-production plant where two machines of the same make, bought at the same time, were used. The maintenance cost of one machine was nearly double that of the other. The department foreman said the difference was accounted for by the difference in the two operators.

Machine tool builders are, therefore, faced with the problem of designing machines—especially for mass-production plants—that will require as little skill and knowledge of machine operation as possible, that will stand up even when used by careless operators, and that will need as few adjustments as possible by the operator.

* * *

REDUCING MISTAKES IN THE SHOP

Nothing impresses the man who has made a mistake in machining work more than a statement of its actual cost in dollars and cents. A definite statement of the cost of mistakes will have a greater effect in preventing similar errors than any other corrective method.

Errors in machining are usually costly. Not only is the time lost that the man who makes the mistake has spent on the work, but also all the time previously spent on the same piece; and often the material is of little or no further value except as scrap. Frequently, the material may be more costly than the time lost. In the tool-room especially, slight errors made by a toolmaker on a die, for example, may cause the loss of a very costly forging; and sometimes several hundred dollars worth of work may have been performed on the die as well, up to the time the mistake was made.

In one shop the number of mistakes made in machining was considerably reduced by issuing to each man who spoiled a piece, a detailed statement of the cost, showing the loss incurred by the firm.

* * *

ECONOMICAL MACHINE DESIGN

One of America's most ingenious machine tool designers once said, "If you have sufficient time and money you ought to be able to design a machine to perform any machine shop operation. Any good designer should be able to do that. The secret is to design a machine in a reasonable length of time that can be built at a reasonable cost."

The necessity for designing machines that can be built at a moderate cost is often overlooked by engineers and designers. Their attention is focussed upon accomplishing the mechanical object in view; and they fail to realize that no matter how successful a machine is in attaining this object, it is commercially a failure if it cannot be built and sold at a price to meet the competition of machines that may be less perfect from an engineering point of view, but more economical to the user.

The designer should always ask himself not only "Can I make it work?" but also, "Will it be economical?" Good engineering requires that careful consideration be given not only to technical principles, but to commercial requirements as well.

The Best Equipped Machine Shop in the World

Visitors to the Cleveland Exposition Will Have an Opportunity to See A Machinery Manufacturing Plant Unequalled in the World

PREVIOUS to the first exposition of the National Machine Tool Builders' Association, held in Cleveland two years ago, MACHINERY referred to it as the "best equipped machine shop in the world," and that designation proved to have been well chosen. For when the show opened, it immediately became evident to every visitor that there was assembled the most modern machine shop equipment ever brought together under one roof. Not only was every machine of the latest type, incorporating the most modern ideas in design and construction; but more than one hundred were shown in operation to the machine tool using industries for the first time—they were of entirely new design, many of them completed and tested but a few weeks before the opening of the exposition.

This fall, during the week beginning September 30, the National Machine Tool Builders' Association will hold its second exposition in Cleveland. Again the men responsible for results in our great machine tool using industries will have an opportunity to examine the best equipped machine shop in the world in operation. The number of exhibitors this year is greater than two years ago. The number of entirely new machines on exhibition will, from all indications, exceed the number in 1927. Almost all the machines will be shown in operation, doing the work for which they have been designed. Five thousand horsepower will be provided to drive this great machine shop. There is no doubt that as a machine tool exposition it will surpass all similar shows that have been held in the past anywhere in the world.

It would be idle to try to enumerate the special features that the visitor will have a chance to inspect; but it may be of interest to mention a few trends in machine tool design that will command attention at the show. Hydraulic feeds will be provided for machines that have not been so equipped in the past; the power and speed required for the full utilization of the newer high-speed cutting materials will be present in many types of machines; broaching equipment embodying new ideas will be featured; and in the automatic turning, milling and grinding machine fields there will be several innovations. These are but a few of the high lights; for in every branch of the machine tool industry there will be on exhibition new equipment—new machines to enable the user to obtain greater production, lower labor costs, and still further refinement in accuracy.

Those who are responsible for the results obtained in machine shop operations cannot afford to miss this opportunity to acquaint themselves with the latest advances in the shop equipment field. It would be a distinct loss to anyone filling a responsible place in the machinery industry, and to his company, to be absent from the machine tool show in Cleveland beginning September 30. Put a red mark on your calendar as a reminder.

The Selection of Industrial Lubricants

By H. L. KAUFFMAN

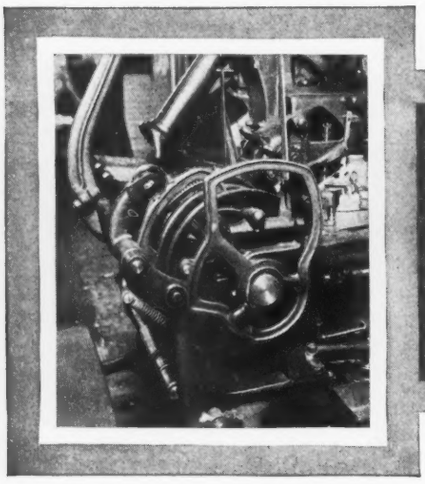
In selecting the proper lubricant for any particular purpose, consideration must be given to the design and operation of all moving parts of the machine, such as cylinders, pistons, valves, bearings, shafts, etc., the speeds and pressures under which they operate, and their relation to each other. Most often these elements are fixed by the design of the machine itself, and, ordinarily, cannot be changed.

Mechanisms exposed to low temperatures necessitate the use of a lubricant that will remain in a fluid condition at the temperatures encountered; whereas, bearings and gears exposed to a high heat demand the use of a lubricant that will retain its body sufficiently to guard against its flowing away; so, too, all lubricants should be selected with climatic conditions definitely in mind.

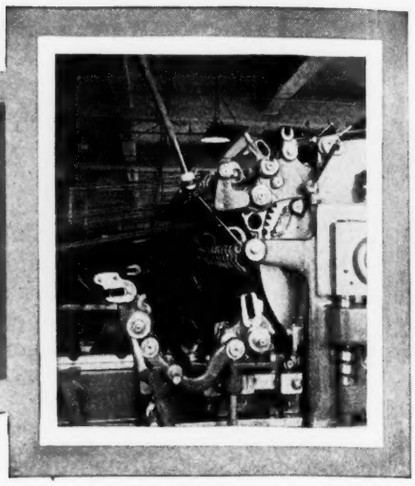
Road dust, rock dust, steel dust, cement dust, moisture, mud, and chemical fumes are other conditions that affect the degree of lubrication secured from the lubricant. Whether or not guards or casings are built around the parts being lubricated to prevent particles of abrasive material from entering the bearing, must also be considered in selecting the lubricant.

Before deciding on a lubricant for cylinder lubrication, the condition of the steam, air, or other elements in use in the cylinders should be investigated; comparatively insignificant causes will often affect the lubrication so that trouble may develop.

Since careless or incompetent workmen are frequently the cause of unsatisfactory service from a lubricant, the character of the men employed—with special reference to the care they will give the machine—should also be considered. The method of applying the lubricant to a machine is another major factor that influences greatly the type and grade of oil or grease that will prove most suitable.



Ingenious Mechanical Movements



ROLLER CLUTCH WITH TRIPPING DEVICE

By JOSEPH S. PECKER, Consulting Engineer, Philadelphia, Pa.

In designing special machinery, it is often necessary to provide a tripping clutch similar to that used on a power press. Such clutches may be required to have the added safety feature of not repeating should the operator fail to take his foot off the starting treadle. Special wire or pipe bending machines, special cutting-off machines, and single-action machines for such operations as gluing, notching, stamping, and scoring, are typical machines on which clutches of this kind are used. To meet the requirements of such machines, the writer developed the clutch shown in Fig. 1. Although not new in principle, the design has been developed to a point where the device is light in weight, compact, and effective in action. Different applications may, of course, necessitate changes in the mounting, treadle action, and driving means.

When the machine is in operation, the flywheel *A* revolves continuously. Shaft *B* remains stationary until the operator depresses the foot-treadle. When the treadle is pressed down, shaft *B* makes one complete revolution and stops, regardless of whether the operator removes his foot from the treadle or keeps the treadle depressed. In order to cause the shaft *B* to make another complete revolution, the treadle must be allowed to return to its normal position and be depressed again.

Briefly, the action of the tripping device is as follows: When the foot-treadle is depressed, the treadle-rod pulls plate *X* to the right against the tension of spring *Y*. This movement brings latch *O* into contact with collar *U* at *V*, causing rod *T* to move to the right against the tension of spring *R*. The downward movement of the foot-treadle is continued until the latch *P* at the end of rod *T* is disengaged from the nose *J* of the friction roller cage, also shown in Fig. 2. The friction roller cage, being thus released, is revolved clockwise on the hub of collar *E* through the action of spring *K* fastened to pins *L* and *M*, Fig. 2. Referring to

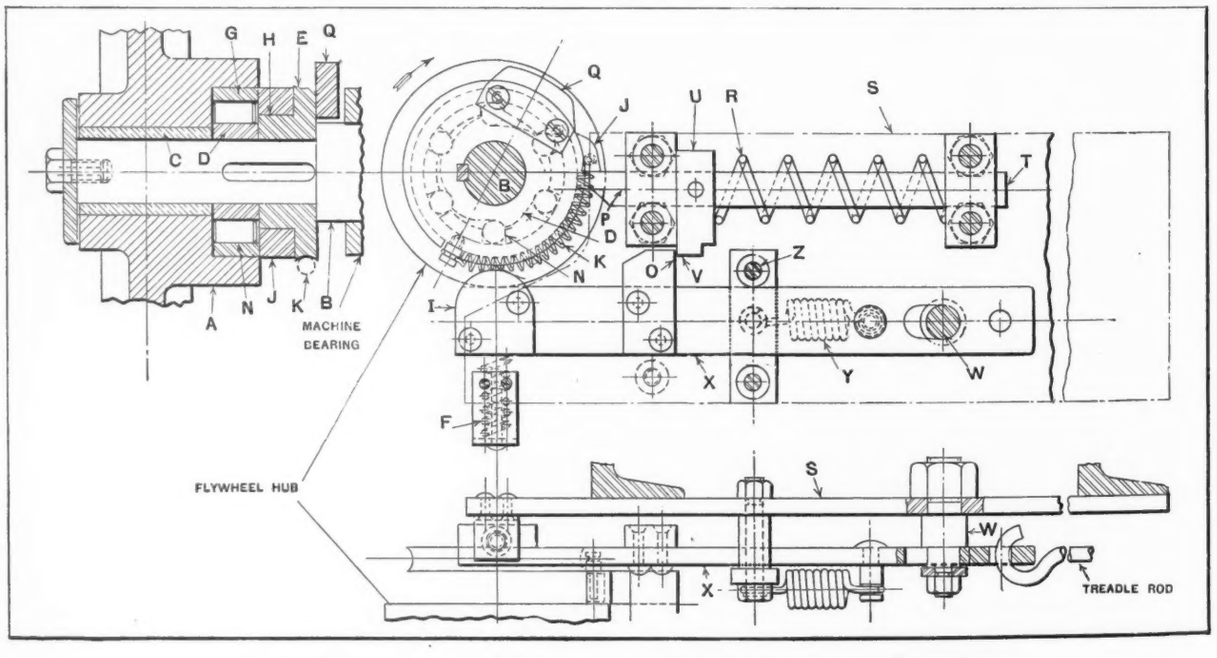


Fig. 1. Roller Clutch with Tripping Device Designed to Prevent Repeating

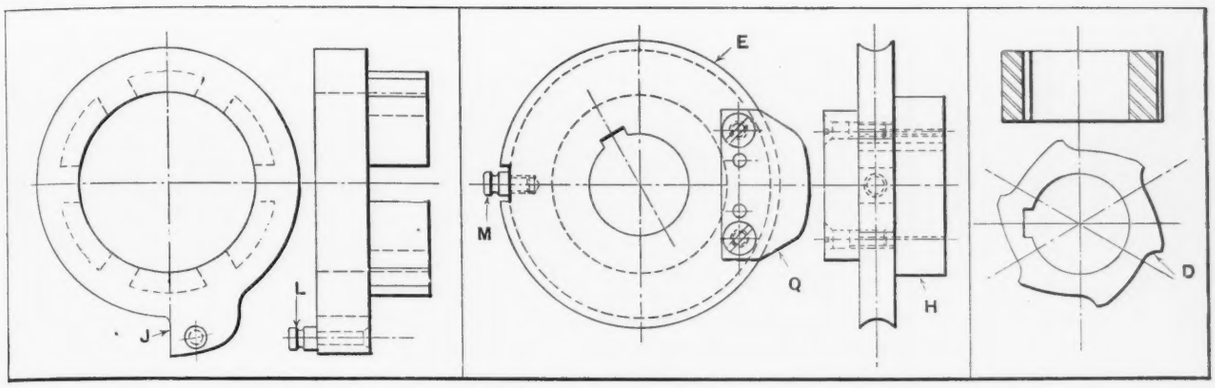


Fig. 2. Roller Cage J, Collar E and Cam D of Clutch Shown in Fig. 1

Fig. 1, it will be noted that collar *E* is keyed to shaft *B*.

Now as the roller cage revolves, it carries the rollers *N* with it, forcing the rolls to climb up the cam surfaces of the cam member *D*, which is keyed to shaft *B*. The rollers finally reach a point where they act as wedges between cam *D* and the hardened steel ring *G*, which is pressed into the hub of the flywheel *A*. Flywheel *A* then drives shaft *B* forward in the direction indicated by the arrow, the roller cage and collar *E* revolving with the shaft.

The shaft *B* is revolved but a fractional part of a revolution before the cam *Q*, secured to collar *E*, comes in contact with the cam *I* at the end of plate *X*, causing plate *X* to pivot about pin *W* against the tension of spring *F*. This action serves to disengage collar *U* from contact with latch *O* at point *V*, allowing spring *R* to force rod *T* back into the position shown, with the latch *P* ready to engage nose *J* of the roller cage when it has made a complete revolution.

As the rolls are prevented from moving forward by the roller cage when nose *J* is stopped by latch *P*, their wedging action between the ring *G* and the cam *D* is released and shaft *B* stops, while the flywheel continues to revolve. All parts of the device are now in the positions shown in Fig. 1, ready for the tripping operation to be repeated. While the treadle-rod and the latches are shown in a horizontal position in the illustration, they are usually located in a vertical position, plate *S* being mounted on the machine frame, portions of which are shown in cross-section in the lower view of Fig. 1. However, the construction is such that the latch can be located at any desired angle relative to the roller cage. To insure efficient operation of the safety device, care should be taken to see that the rod *T* slides freely in its bearings, and that spring *R* has a very snappy action. All wearing parts should, of course, be hardened.

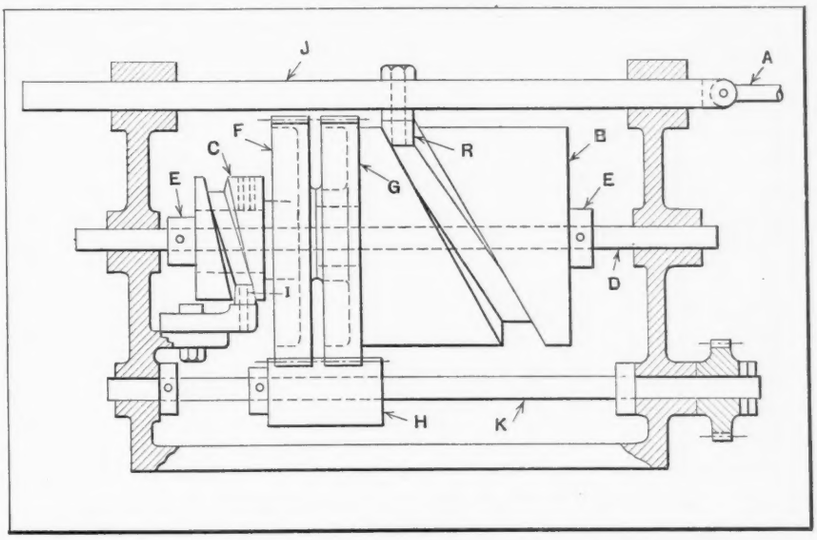
* * *

VARIABLE-STROKE MECHANISM

By V. J. SCOSE

The purpose of the mechanism shown in the accompanying illustration is to impart a variable-stroke motion to rod *A*. This is accomplished by two cams *B* and *C*, mounted on shaft *D*. These cams are a free running fit on shaft *D*, and are held in place by two collars *E*. Cam *C* is keyed to the hub of gear *F*, which has 100 teeth. Gear *G*, which has 111 teeth of modified form and is of the same diameter as gear *F*, is keyed to the hub of cam *B*, which transmits motion to rod *A* through roll *R* and bar *J*.

The gears *F* and *G* are both driven by the wide-faced pinion *H*, secured to shaft *K*. The cam roll *I* is mounted on a bracket secured to the machine frame, and remains in a fixed position. As the gears *F* and *G* revolve, the former gains eleven teeth on the latter at each revolution, thus shortening and lengthening the throw of slide bar *J* and rod *A*, the stroke being lengthened when the relative angular positions of the cams are such that they impart motion in the same direction, and shortened when the motion imparted by the cams is opposed.



Double Cam Arrangement for Producing Variable Stroke

Common Sense in Helical Spring Design

To Obtain the Best Results in Using Helical Springs, Select as Large Springs of the Required Capacity as Conditions Will Permit

By A. B. COX

THERE is one simple guide to good spring design which, if followed by the designer, invariably results in a good spring, but which, if neglected, usually results in unnecessary expense and other troubles.

Although the formulas for helical springs are not complex, and the use of these formulas is made still easier by the "spring tables" in handbooks, there is still a surprising amount of poor spring design. By this I do not mean that springs are commonly designed so that they will not carry the loads intended, though even this is sometimes true. It is easy to pick out from a spring table a size of spring that will carry whatever load is desired. The trouble is that usually a spring of wrong characteristics is chosen, so that unnecessarily great stresses are thrown on the remainder of the parts of the machine of which the spring is a member, thus necessitating heavier and more expensive design for these parts than would have been the case with a properly selected spring.

Spring Designs that Have Failed Because an Important Factor was Overlooked

Three instances of poor spring design will be given. (1) In a line of spring brakes with electromagnetic release, for use with electric motors, springs of such characteristics were chosen that the electromagnet coils which operated the release levers had to be made unreasonably large and expensive, the release lever arm had to be made extraordinarily heavy and stiff, and adjustment for wear was frequently required. (2) In some automobile engines, the valve springs are so chosen that undue pressure, with resultant wear, comes on the camshaft. (3) In the base of a trolley pole, where the springs are intended to hold the trolley pole wheel against the wire with a given pressure, the springs were so chosen that the swivel bearings of the trolley base were subjected to such pressure that they were continually failing in service.

Load Carrying Capacity is not All that is Required of a Good Spring

Such examples might be multiplied almost without limit; everyone has seen similar instances of poor spring design. The difficulties in all three of the cases could have been avoided by the choice of springs of proper characteristics. Nearly always, what is wanted in a helical spring is a spring that not only will carry the load desired, but that will also stand a given amount of additional compression (or extension, if the spring is a tension spring) with the minimum increase in total load. For example, what is wanted in the spring brakes with electromagnetic release, is a spring that not only will have the required braking effect, but that will also permit the electromagnet lever to compress the spring the additional amount necessary to release the brakes, with the minimum increase in total spring load. What is wanted in the automobile engine is a spring strong enough to close the valve as fast as its cam will permit and then hold it tightly shut, and yet compress with a minimum pressure on the cam when the valve opens.

What is wanted in the trolley base is a spring that will hold the trolley wheel firmly against the wire, even when the wire is at its highest point, and that will compress the additional amount necessary to allow the wheel to ride on the wire when the wire is at its lowest point above the car (under bridges, etc.), but with a minimum of stress in the trolley base. In the case of the trolley, the springs must also be designed so as to permit of the complete lowering of the trolley pole flat against the car roof without over-stressing the springs. This requirement, of course, greatly increases the difficulty of the problem unless the designer thoroughly understands the characteristics of springs.

The Spring of a Given Capacity that has the Greatest Diameter and Length is the Spring to Select

The spring that will hold a given load, and yet will compress an additional amount with the least increase in spring load, is the spring that has the greatest diameter and length for which it is possible to arrange space in the complete machine. The simple guide to good spring design mentioned at the beginning of this article is, then: *Always choose the largest spring within reason.* Do not choose a very short spring of very small diameter. The extra cost of the larger spring will be more than absorbed in the smaller cost of the remainder of the related machine parts and in the longer life and more satisfactory operation of both the spring and the machine to which the spring is attached. An extreme example will make this clear.

Comparison of Two Spring Designs

Suppose, for the sake of easy comparison of load change, that a spring is to hold a valve closed with a force of exactly 100 pounds, and that the spring has to be compressed an additional amount of 1 inch to allow the valve to open fully. The spring is to be wound so as to have 1/16 inch clearance between turns when the valve is fully open, that is, when the spring is compressed its greatest amount. The ends of compression springs nearly always

have to be ground square with the spring axis by the manufacturer, and each of these partially ground-away end-turns then has to be set up solidly against the next adjacent turn for support. One turn on each end of the spring is, therefore, inactive, and to determine the number of active turns, two turns must be subtracted from the total.

By the aid of spring tables for round steel wire, I have selected two springs of equal strength but of widely differing characteristics, for comparison. Design No. 1 is a spring of 4-inch mean diameter, 5/16-inch diameter wire, and 7 inches long when compressed to have the desired minimum 1/16-inch clearance between turns. Design No. 2 is a spring of 7/8-inch mean diameter of 3/16-inch wire, 3 inches long when compressed to 1/16-inch clearance between turns. With 100 pounds load on each spring, spring No. 1 is 8 inches long, and spring No. 2 is 4 inches long. When each spring is compressed 1 inch or more (to 7 inches and 3 inches, respectively, when the valve opens), the load on No. 1 increases from 100 pounds to approximately 113 pounds, a net increase of 13 per cent; the load on No. 2 increases from 100 pounds to approximately 356 pounds, a net increase of 256 per cent.

Spring No. 2 will be stressed beyond its elastic limit, and either break or be permanently deformed. Even with the same length as spring No. 1, the load on No. 2 increases 116 per cent above the original 100-pound load, on being compressed the additional 1 inch required to open the valve. Even though space considerations would prevent the use of quite as large a spring as chosen for this comparison, the advantage of using as large a spring as practicable is obvious. Tension springs, of course, work out approximately the same.

Design that will be Least Likely to Break Due to Resonance under Repeated Stress

Incidentally, when as high a stress as practicable is used in the spring material, a long spring of large diameter, as here recommended, happens also to be the one best suited to avoid breakage due to mechanical resonance under repeated stress. In commenting on the results of their tests run to determine this point, Jehle and Spiller make a striking statement in "Valve-Mechanism Idiosyncrasies," S.A.E. *Journal*, Volume 24, No. 2, February, 1929, page 141. They say that in order to avoid harmonic vibration of the spring, the smallest size wire consistent with stress, etc., should be used, and the number of coils and their diameter should be as large as possible, the wire size being the most important factor. This consideration of wire size and economic consideration of the space available for the spring both tend to reduce the diameter and length of springs that are subject to rapidly repeated stress to more reasonable dimensions than those of the extreme design chosen for purposes of illustration. Where mechanical resonance is likely to be the determining factor in the design, reference should be made to the formulas and explanation in the Jehle and Spiller article.

Other Practical Considerations in Selecting the Best Spring for the Purpose

There are a number of practical points of spring design that can often be used to advantage. Do not use two small springs in parallel; instead, use one large spring. Long springs of large diameter may sometimes be more difficult to assemble than short springs of small diameter. Means of adjustment (by screws, shims, etc.) should be provided when it is important to have a certain definite pressure, or when a certain pressure must be approximately maintained in spite of wear or distortion of the machine parts. Some designers, whenever operating conditions permit, use "stops" which act to prevent over-compression or over-extension of the spring; some make compression springs with such a clearance between the turns that the turns compress solidly before the safe carrying capacity of the spring is exceeded. The spring then acts as its own stop.

Springs that operate rapidly over long periods of time must be designed with the stress below the fatigue limit of the material, or else the springs will break after a period of service. When loss of life or extensive damage to property would be caused by breakage of the spring, when replacement of the spring would be difficult, or when loss due to the machine being out of operation is important, a correspondingly large factor of safety should be used in calculating the strength of the spring. A mean diameter of at least three times (preferably more) the diameter of the spring wire should be used to prevent cracking or breaking of the wire when winding the spring. The use of noncorrosive or rustproof material is often desirable.

Each of these practical points has some value to the designer, but most designers that fail in their spring design appear to fail through neglecting the principle that to obtain desirable characteristics in a spring, a large spring must be chosen, rather than through neglecting any of the practical points enumerated.

* * *

DIESEL ENGINE MANUFACTURERS' ASSOCIATION

With the rapid growth in the use of Diesel engines for almost all kinds of service in the industrial, public utility, railway, automotive, aviation, and marine fields, the manufacturers of these engines have realized the need of a closer contact within the industry, and as a result, twelve of the leading builders, representing nearly the entire output of Diesel engines in the United States, have organized the Diesel Engine Manufacturers' Association at 30 Church St., New York. The president is Henry R. Sutphen, president of the Electric Boat Co.; vice-president, E. T. Fishwick, vice-president of the Worthington Pump & Machinery Corporation; and secretary and treasurer, Harlan A. Pratt, manager, Oil and Gas Engine Department, Ingersoll-Rand Co. M. J. Reed is research engineer.

Standardized Jigs for Production Drilling

Details of Standardized Drill Jigs Equipped with Quick-acting Work-clamping Levers and Adapted for a Large Variety of Work

By C. B. COLE

COMPETITION is forcing manufacturers of metal products to use the most efficient and economical tool equipment obtainable and to constantly seek new methods of lowering production costs. As machine tools are invariably operated at the highest speeds and feeds of which they are capable, the problem of reducing production time generally concerns the work-handling methods. Thus, in drilling operations, for example, it is necessary to design drill jigs that can be loaded and unloaded in the shortest possible time.

In some cases drilling costs have been lowered on steady production runs, where the design is not likely to be changed, by using multiple drilling heads and by designing jigs that are capable of handling two or more pieces at one time. Also, multiple-spindle drill presses have been used in conjunction with multiple jigs.

The average manufacturer does not have sufficient work to warrant the steady employment of a special tool engineer, as does the automobile manufacturer. Instead, a technical man is generally employed who is more or less of an all-around designer, but who is not expected to be a specialist on tooling equipment. Under these conditions, standardized jigs, such as described in this article, can be used to advantage. These jigs can be made at a reasonable cost and can be easily adapted to suit the requirements of most jobs from the standpoints both of accuracy and production.

By using standardized jigs, the expense for tool designing is greatly reduced, as is also the cost for patterns. The single-action automatically locking jig shown in connection with Table 1 enables the operator to load the jig quickly and clamp the work in place with a single pull of the lever. Upon completing the drilling operations, the clamping mechanism is automatically unlocked by moving

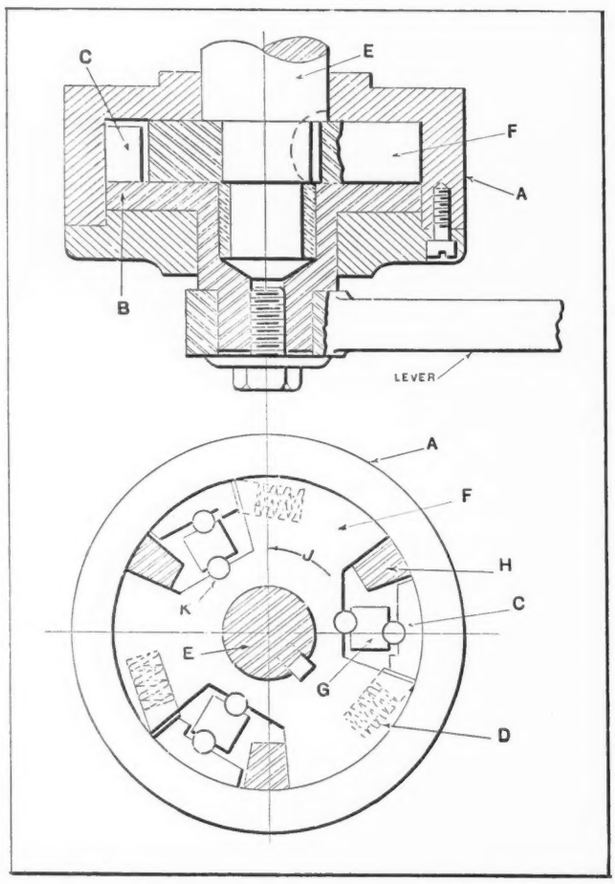


Fig. 1. Friction Locking Mechanism for Clamping Lever of Drill Jig

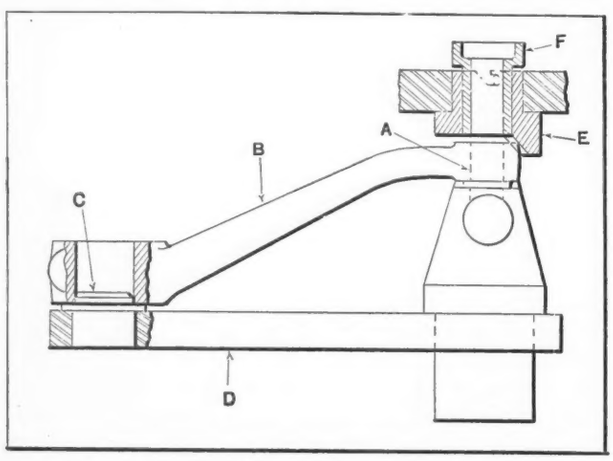


Fig. 2. Adapter and Top Plate Used on Standardized Jig for Drilling Steering Arm Rods

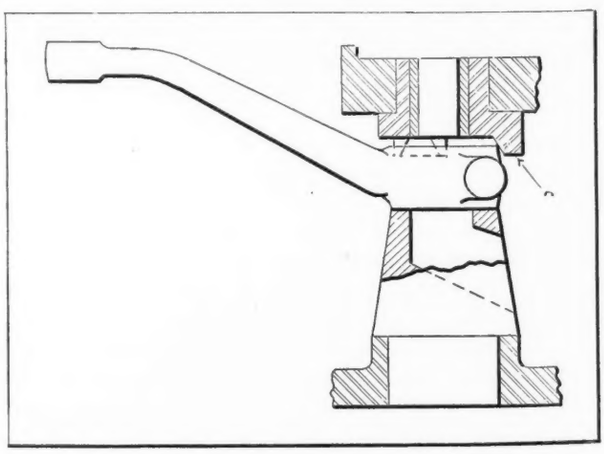


Fig. 3. Method of Holding Automobile Steering Arm Rod when Drilling Large Hole

the lever in the opposite direction. The old type of latch, set-screw, or other locking device is thus eliminated.

Design of Clamping Device

The automatic locking device for the clamping lever of the standardized jigs is shown in Fig. 1. The end of the lever fits the hexagonal end of member *B* so that the position of the handle can be changed to suit the convenience of the operator.

The shaft *E* has a steel disk *F* secured to it by means of a Woodruff key. Three equally spaced slots are milled in this disk to receive the hardened steel shoes *C* which exert the required friction-locking action through the pressure imparted by the toggle members *G*. Steel springs *D* in back of shoes *C* hold them in position. The view at the top of Table 1 shows how the clamping lever and locking device are applied to the jig.

Shaft *E*, Fig. 1, in the case of the type of jig shown in Tables 3 and 4, has two pinions at points some distance apart, which actuate two racks to which a clamping plate is attached. The racks act as posts in the case of the jig shown in Table 3, the clamping action being downward. After a piece is placed in the jig, it is clamped by a movement of the lever secured to member *B*, Fig. 1.

The three evenly spaced lugs *H* on the inner face of member *B*, coming in contact with the sides of the slots in disk *F*, cause the disk and shaft *E* to revolve in the direction of arrow *J* when the clamping lever is moved in that direction. The movement of the lever is continued until the pinions secured to shaft *E* have exerted the required clamping pres-

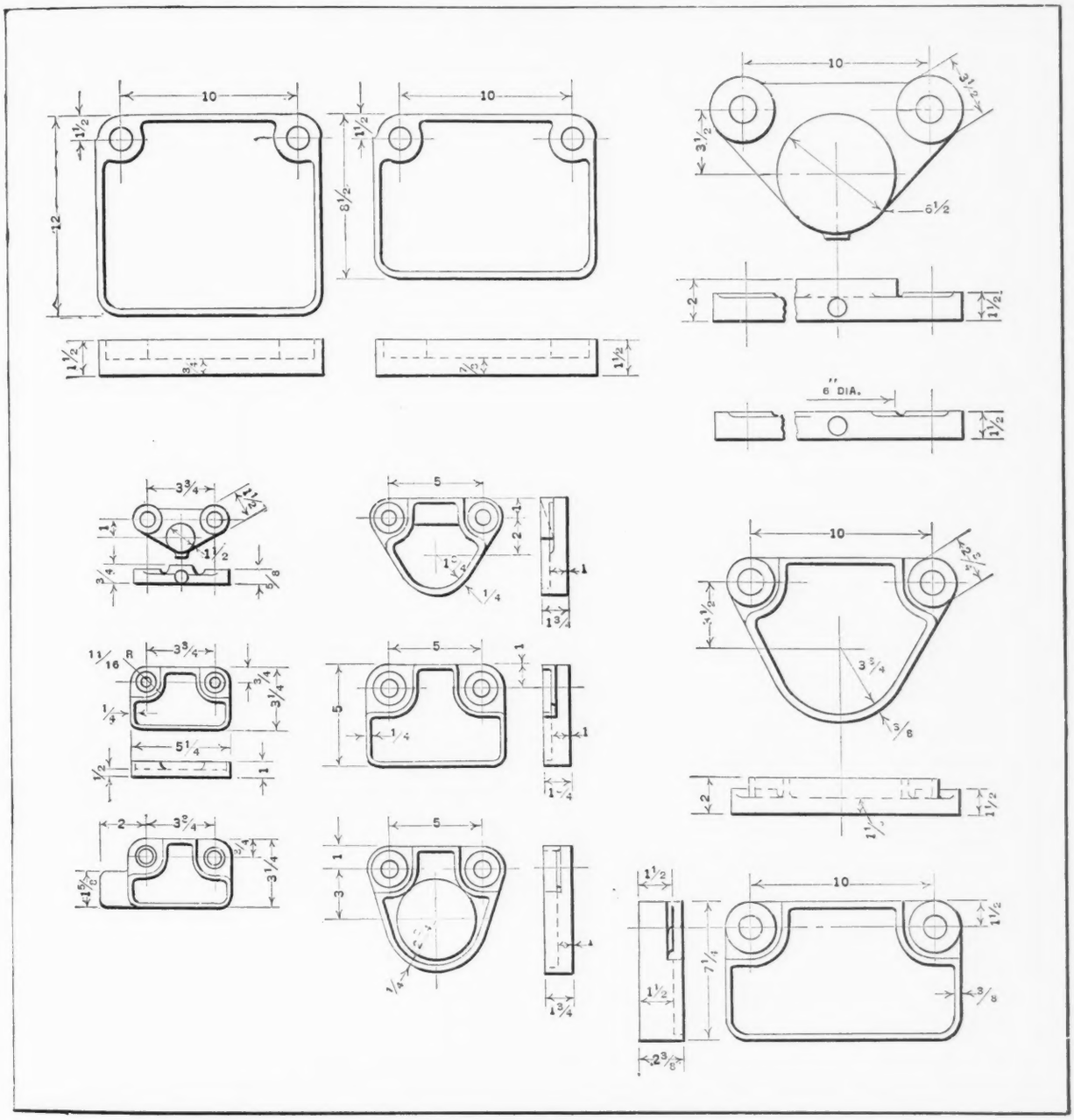


Fig. 4. Clamping Plates of Various Designs Used on Type of Fixture Shown in Table 3

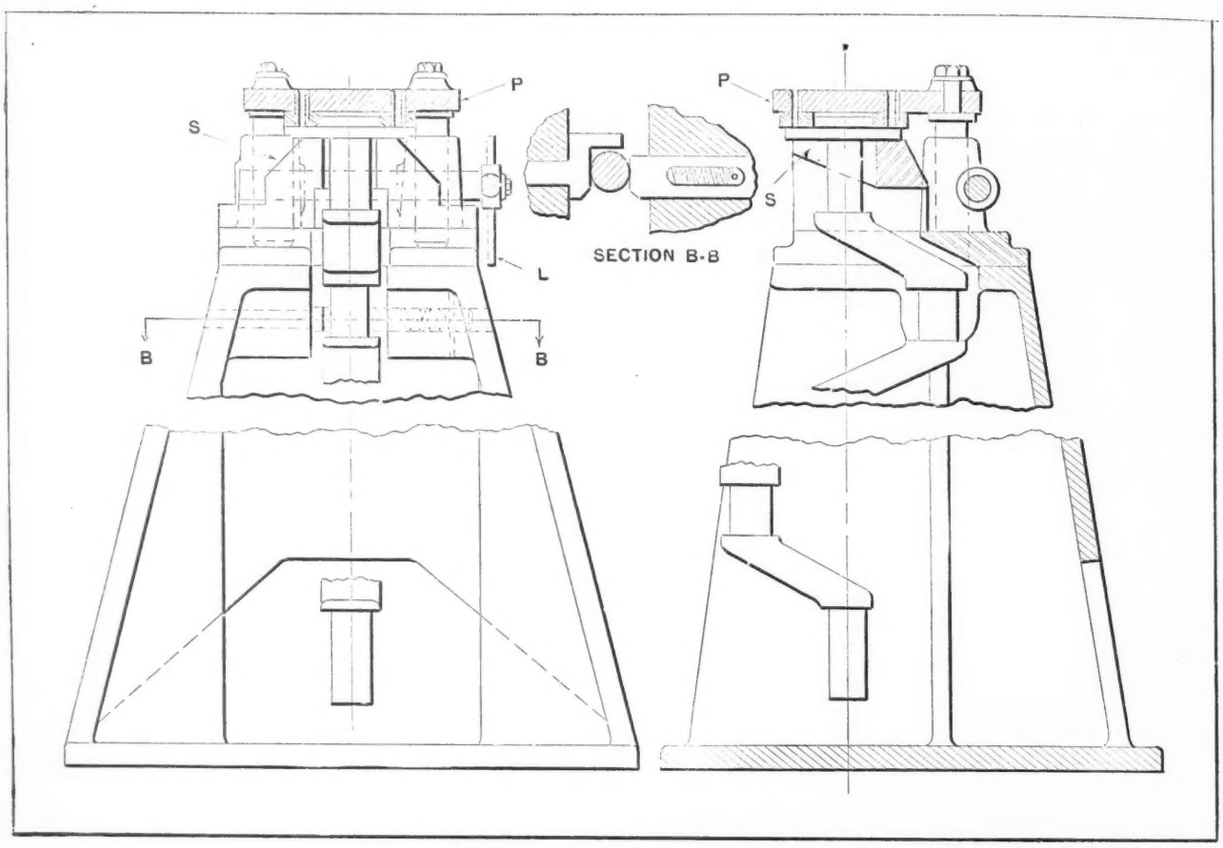


Fig. 5. Two-pillar Type of Standardized Jig Adapted for Drilling Flange of Automobile Crankshaft

sure on the work through the medium of the racks with which they mesh.

The locking device then prevents the racks from releasing their pressure on the work, as shaft *E* is kept from turning in the opposite direction by the friction shoes *C* which are forced outward against the stationary casing *A* by the action of toggles *G*. The friction thus set up is sufficient to hold the work in place until it is released by moving the lever in the reverse direction. The reverse movement of the lever causes lugs *H* to force the friction shoes backward, so that the toggles *G* cease to exert pressure on shoes *C*. Thus the backward movement of the clamping lever first unlocks the grip on the work and then causes the clamping plate to recede from the work. The method of using rolls *K* for the toggle bearings is clearly indicated in the lower view of the illustration Fig. 1.

In the case of the jig shown in Table 1, the shaft has one pinion milled integral with it, which meshes with a rack milled on the post located in the center of the jig base. The clamping action is upward in this type of jig, the part being pressed or locked against the top plate of the jig. The open type of jig shown in Table 3 is used where minimum obstruction to loading and unloading operations is necessary. The type of jig illustrated in Table 1 is arranged to take care of bell-shaped housings, couplings, flanged hubs, and parts of similar shape.

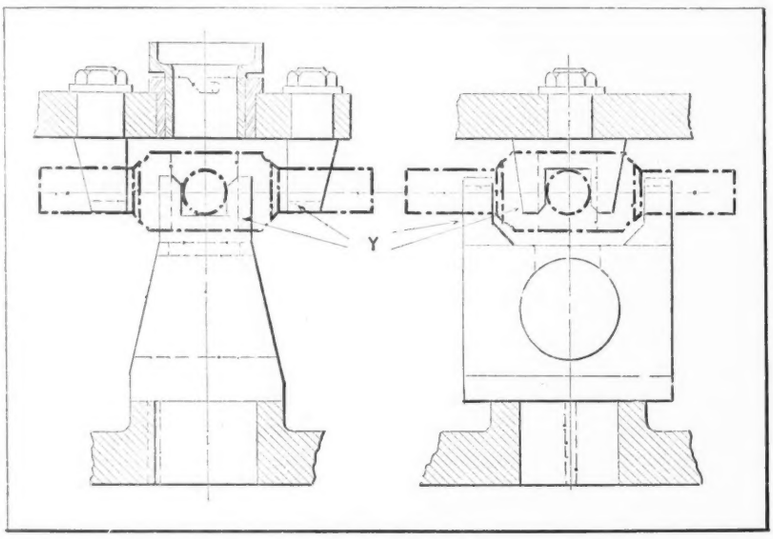
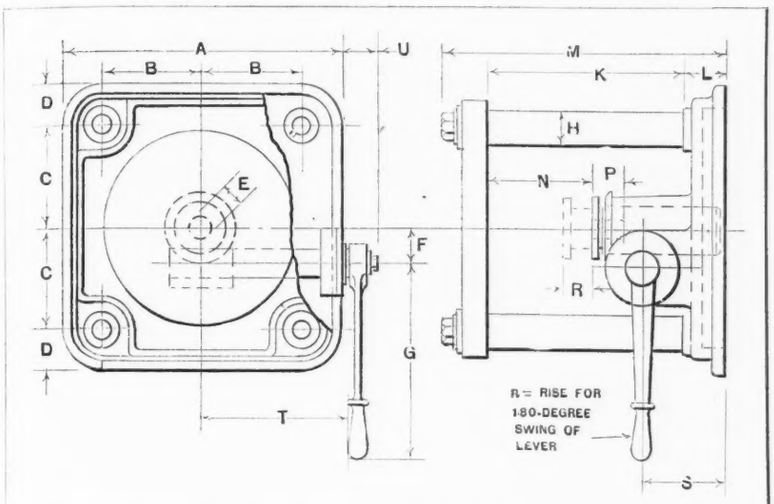


Fig. 6. Adapters for Drill Jig Employed in Drilling the Central Hole in Differential Spiders

Advantages of Standardized Jigs

One of the outstanding advantages of standardized jigs is that they do not become obsolete when the design of a part is changed. A new top plate and adapter can be made, and the body of the jig, which is the most expensive part, can still be used except where a material change is made in the overall dimensions.

Table 1. Dimensions for Standardized Drill Jigs*



A	6	8 1/8	12	17 3/8	21	24 3/4	33
B	2 3/16	3	4 1/4	6 1/2	8	10	13 3/4
C	2 3/16	3	4 1/4	6 1/2	8	10	5 3/4
D	13/16	1 1/16	1 3/4	2 3/16	2 1/2	2 3/8	2 3/4
E	1/2	3/4	1	1	1	1	1
F	0.750	1.083	1.500	1.500	1.500	1.500	1.500
G	8	8	11 3/8	11 3/8	14	14	14
H	5/8	7/8	1 1/4	1 1/2	1 1/2	1 3/4	1 3/4
K	4 3/4	7	8 1/2	13	15	21	14
L	7/8	1	1 5/8	1 3/4	1 3/4	1 3/4	1 5/8
M	6 1/2	9 3/16	11 7/16	16 5/8	18 9/16	25 3/16	17 13/16
N†	2 3/4	4 3/8	4 3/4	9 1/8	11	16 3/8	8 13/16
P	7/8	1 1/16	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
R	7/8	1 5/8	2	2	2	2	2
S	1 11/16	2 3/8	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2
T	4 1/8	5 1/4	6 3/4	9 3/8	10 7/8	12 7/8	17
U	2 1/4	2 5/16	1 7/8	1 13/16	1 1/2	1 5/8	1 5/8

*Dimensions of plates are given in Table 2.
†Dimension N can be made to suit requirements by using special posts.

In small plants where the expense for tools must be held to a minimum, standardized jigs make possible a considerable saving, because one jig can be used for drilling a number of different parts by using interchangeable top plates and adapters. This is particularly true where a product is made in several sizes in limited quantities. A few jigs of this type, properly distributed around the plant, can be used for many different parts. Plates or adapters can be changed so quickly that there is no appreciable loss of time.

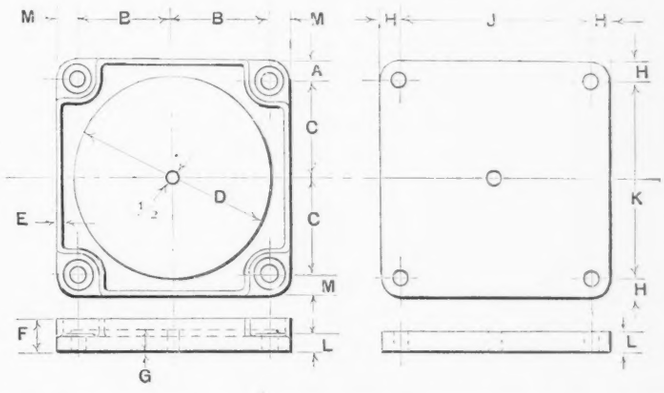
The jigs shown in the accompanying tables are particularly useful in cases where a standardized machine that has been on the market for a period of years is superseded by a completely redesigned type. The drilling of replacement parts for the old type of machine, which may be necessary for a number of years, is readily taken care of by the old top plates and adapters for the jigs, which can be properly labeled and put away until there is a demand for replacement parts. This is more economical than the old method of building individual jigs to suit each particular part. In the smaller plants, the provision of storage space for obsolete or inactive tools becomes quite a problem after a few years if a separate jig is made for each part.

Using Standardized Jigs for High-speed Production

Automobile manufacturing plants were the first to make use of standardized drill jigs. Although the speed with which drilling work could be handled on standardized jigs was recognized as a desirable feature, the difficulty often experienced in obtaining the services of a tool designer who could design complete jigs that would fit in with the scheme of production when tooling up for a new model was a more decisive factor favoring the adoption of jigs of this kind for automobile plant work. Standardized jigs were applied to such parts as steering arm connecting-rods, differential spiders, camshaft brackets, and other miscellaneous parts.

In Fig. 2 are shown the adapter and top plate used on one of the standardized jigs for drilling the hole at *A* in a steering arm connecting-rod *B*. In this case, the hole at the large end

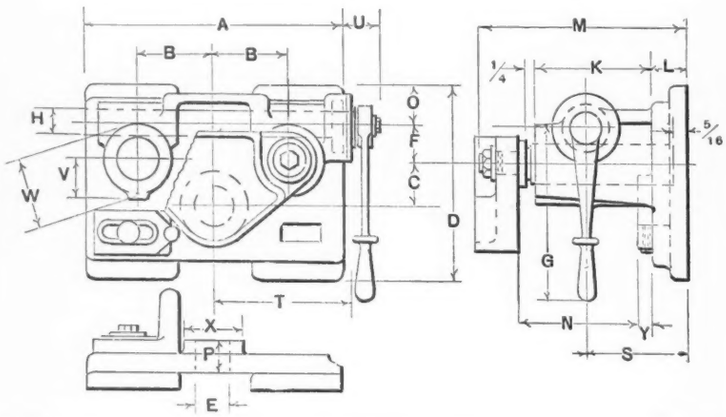
Table 2. Dimensions of Plates for Drill Jigs*



B	2 3/16	3	4 1/4	6 1/2	8	10	13 3/4
C	2 3/16	3	4 1/4	6 1/2	8	10	5 3/4
D	4	6	8 1/2	13	16	18	
E	1/4	1/4	5/16	3/8	3/8	3/8	5/8
F	15/16	1 1/8	1 3/4	2 1/4	2 1/4	1 3/4	2 1/4
G	5/8	3/4	7/8	1 1/4	1 1/4	1 3/8	1 1/4
H	1/2	5/8	1	1 1/8	1 1/16	1 1/16	1 1/2
J	4 3/8	6	8 1/2	13	16	20	27 1/2
K	4 3/8	6	8 1/2	13	16	20	11 1/2
L	1/2	11/16	3/4	1 1/16	1 1/8	1 3/4	1 1/2
M	1/2	5/8	1	1 1/8	1 1/16	1 1/16	1 1/2

*Dimensions in this table are for plates to be used with jigs dimensioned according to Table 1. Plates are bored to fit jigs. All dimensions are for finished sizes.

Table 3. Dimensions for Standardized Jigs*



A	6	6	8	11	11	14 1/2	16
B	1 7/8	1 7/8	2 1/2	3.252	3.252	5	5
C	1	1 to 2 1/2	2	2	2 to 3 1/2	3 1/2	3 1/2
D	4 1/2	5 5/8	7 1/8	8 1/2	9 1/8	11 1/2	12 1/2
E	1	1	1 1/2	2	2	2 3/4	3 1/2
F	0.750	0.750	1.150	1.400	1.400	1.625	1.750
G	8	8	9 1/4	11 3/8	11 3/8	13	13
H	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2
K	2 7/8	2 7/8	4 3/4	5 1/4	5 1/4	7	10 1/2
L	7/8	7/8	1 1/2	2	2	2 3/8	2 3/4
M	5 5/16	5 5/16	8 3/8	9 1/2	9 1/2	12 7/8	17
N	2 15/16	2 15/16	4 1/4	5	5	6 3/8	9
O	1 1/8	1 1/8	1 3/8	1 1/2	1 1/2	2 1/2	2 3/8
P	7/8	7/8	1 3/8	1 3/4	1 5/8	2 5/8	2 5/8
R†	7/8	7/8	1 5/8	1 5/8	1 5/8	2	2
S	2 1/4	2 1/4	3 1/2	4 7/8	4 7/8	6	8 1/8
T	4 1/8	4 1/8	5 1/8	6 5/8	6 5/8	8 5/8	8 5/8
U	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/2	1 3/4
V	7/8	7/8	1 1/4	1 3/4	1 3/4	1 7/8	2 1/16
W	1 5/8	1 5/8	2 1/2	3 1/4	3 1/2	3 3/4	4 1/8
X	1 9/16	1 1/2 by 3	2 7/8	3 7/8	3 7/8 by 5 1/8	4 7/8	6 5/8
Y	3/8	3/8	7/8	13/16	13/16	1 5/16	1 5/8

*Dimensions of plates are given in Table 2.
†R = Rise for 180-degree swing of handle.

of the rod is located by a plug *C* on the lower plate *D*, while the small end is centered and clamped in place with the two-prong bell-type bushing *E*, located in the top or clamping plate. The drill guide bushing *F*, in turn, is mounted in bushing *E*. A similar method of locating and holding the rod for drilling the large hole is shown in Fig. 3.

In Fig. 5 is shown one of the two-pillar type of standard jigs adapted for drilling the holes in the flange of an automobile crankshaft. The section *B–B* shows the guiding support located in the base of the jig. In using this type of jig, it is simply necessary to place the crankshaft in the position shown and swing over the clamping lever *L*. This causes the bushing plate *P* to clamp the flange down on the support *S*. The holes are then drilled by feeding the multiple drilling head downward. The drilled crankshaft is released by simply swinging back the lever *L*.

The adapters for use in drilling the central hole in differential spiders are shown in Fig. 6. In this case, four yokes *Y* serve to hold the spider in position while the central hole is being drilled. It will be noted that two of the yokes are secured to the top plate and that two are machined on the lower supporting member.

At the left, Fig. 7, is shown equalizing work-locating adapters applied to a standardized jig for use in drilling the central hole in a camshaft bracket *A*. At *B* is a three-prong bell-mouthed locating bushing mounted in the top clamping plate, and at *C* is the three-prong adapter which centers the lower end of the bracket. At *D* is a stop which prevents the bracket *A* from turning while the center hole is being drilled and reamed.

In the view at the right, Fig. 7, are shown holding adapters employed in drilling the holes in the flange of the bracket. The equalizing locaters *E*, secured to the top clamping or bushing plate, serve to line up the work, which is held in the proper vertical position by the plugs *F* and *G*.

Applications in a Tractor Plant

An outstanding example of the use of standardized jigs in a tractor manufacturing plant is found in the drilling operations on valve levers or rocker arms for a four-cylinder engine. Originally, the method of drilling the center hole was to use six specially designed jigs on a six-spindle drill press. The design of this jig was such that the operator was in danger of injury from the revolving tools. By

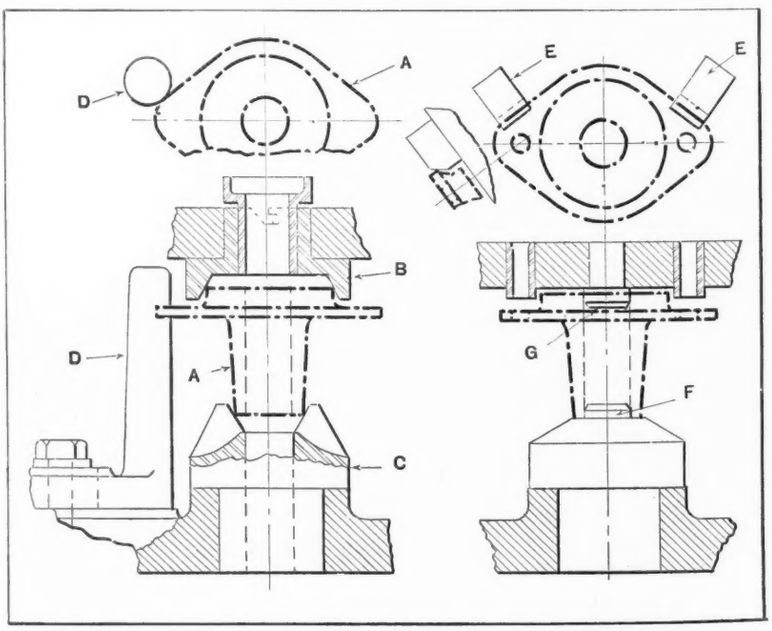


Fig. 7. Equalizing Work-locating Adapters for Drilling Camshaft Brackets

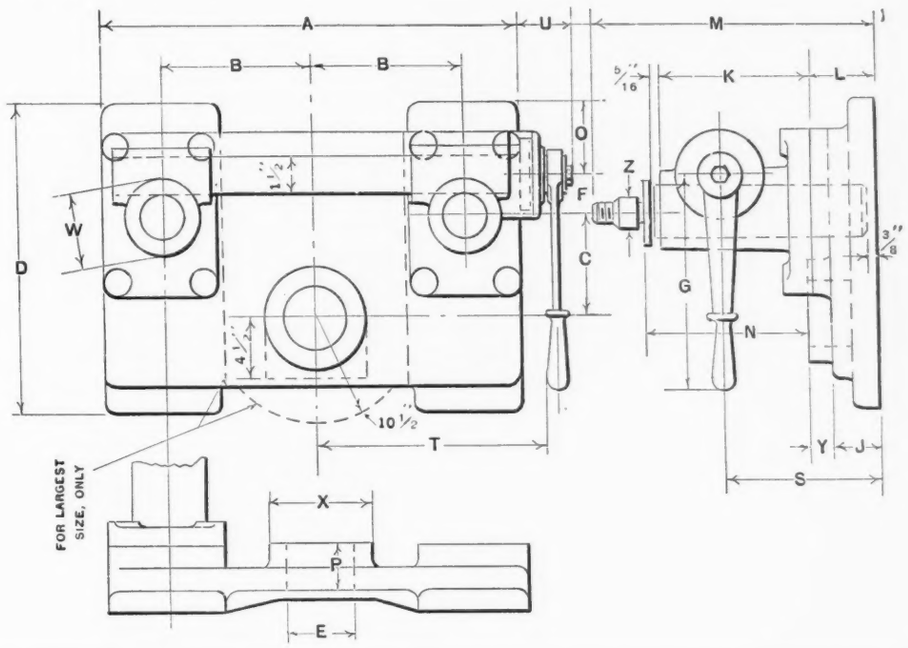
using one of the new open type standardized jigs with a lower adapter formed to fit part of the contour of the work and a similar adapter for the upper part, it is impossible for the operator to load the jig in any but the correct position. The adapter plates (not illustrated), which in a way resemble drop-forging dies, serve to hold the work securely and accurately in place.

As the jig in this case is entirely open at the front, the operator is in no danger from the tools. The six standardized jigs used for this work cut factorily on a standardized jig made at a cost of $175, thus showing a substantial saving in the initial cost. A saving in production time, due to the rapidity with which the standardized jig could be loaded and unloaded, was also achieved.

Jigs for Drilling Pump Parts

Certain manufacturers of centrifugal pumps found that standardized jigs could be readily applied to their production work, particularly in drilling the lower and upper casings of pumps,

Table 4. Dimensions for Standardized Jigs



A	B	C	D	E	F	G	J	K	L	M
15 1/2	5	3 1/2	11	2 3/4	1 5/8	11 3/8	2 1/4	8	2 5/8	14 1/8
19 3/4	7 1/8	3	12 3/4	3	1 5/8	11 3/8	1 1/4	8	3 1/4	14 3/4
31 1/2	13	2 1/2	12 1/4	4	1 5/8	11 3/8	1 5/8	8	2 1/16	13 9/16

N	O	P	R*	S	T	U	W	X	Y	Z
6 1/8	2 1/4	3 5/8	2	7 1/8	8 5/8	2	4	4 1/4	2 7/8	1 3/8
8 7/8	2 1/4	3	2	7 3/4	10 3/4	2	4	4 7/8	1 3/4	1 3/8
7 15/16	2 5/8	2 3/4	2	6 9/16	16 5/8	2	4	6	1 1/8	1 3/8

*R = Amount plunger rises for 180-degree swing of lever.

the floor-to-floor time approximately 50 per cent. At the present time this plant has about thirty-five standardized jigs in service and is providing additional ones as rapidly as possible.

Savings Resulting from Use of Improved Jigs

In another tractor manufacturing plant engaged in the production of very large machines, it was necessary to provide tool equipment for drilling eleven small parts that were manufactured in lots of 50 to 100 per year. The estimated cost of tool equipment for these parts was approximately $390. Instead of providing separate jigs of the usual design, it was found possible to handle the work satisfactorily on a standardized jig made at a cost of $175, thus showing a substantial saving in the initial cost. A saving in production time, due to the rapidity with which the standardized jig could be loaded and unloaded, was also achieved.

Jigs for Drilling Pump Parts

Certain manufacturers of centrifugal pumps found that standardized jigs could be readily applied to their production work, particularly in drilling the lower and upper casings of pumps, where the bolt holes in both parts must line up very accurately with each other and with the cores. A four-post jig of the general type shown in Table 1 was provided for use in drilling the bearing caps.

A special adaptation of one of these jigs was also made for use with an indexing jig, so that all four flanges of a centrifugal pump could be drilled at one setting with a multiple-spindle drill. Clamping mechanism of the design used on the new type jigs is also used by the manufacturers in constructing other boring and milling fixtures.

Referring to Table 1, the first column gives all the necessary dimensions for constructing a standardized jig having four posts spaced as indicated

by dimensions *B* and *C*. In this size of jig, the maximum height *N* from the clamping plunger to the lower side of the plate is given as 2 3/4 inches, but as stated in the footnote, this height can be made to suit requirements by using special posts.

The other columns to the right in Table 1 give the dimensions for a series of jigs of greater capacities. In Table 2 are given the dimensions for top plates for use on the jig shown in Table 1. In Table 3 are given the dimensions for a two-post standardized jig of the open type design, which exerts a downward clamping pressure on the work. In Fig. 4 are shown clamping plates of various shapes and sizes designed for use in fixtures of the type shown in Table 3. Table 4 gives dimensions for a two-post fixture of slightly different type.

* * *

THE MANUFACTURE OF HAIRSPRINGS

Hairsprings, used to control the rate of oscillation of a balance, as in watches, chronometers and various other timing instruments, are of three main types: (a) the straight or torsion type, used as suspension in galvanometers; (b) the flat coiled (spiral) type used in watches; and (c) the helical type used in chronometers. The materials used for hairsprings, and the processes of manufacture, according to a paper read before the Institute of Metals (London) by H. Moore and S. Beckinsale, depend upon the qualities especially required for specific applications. The qualities sought for in hairsprings are perfect elasticity throughout the maximum range of deflection applied; permanence and invariability of elastic properties (and of physical dimensions when under a given torque); and resistance to corrosion.

Hairsprings are made principally of carbon steel; non-ferrous alloys, such as phosphor-bronze and nickel-silver; steel containing nickel and chromium; and palladium alloys. Carbon steel (with 1 to 1.3 per cent carbon, and very low in sulphur and phosphorus) is most frequently used, because it has a much longer range of perfect elasticity than the other materials. Also it is harder than the other materials, and may be used without being tempered to its maximum hardness. Thus it is not as liable to physical injury as the other materials. Carbon steel, however, has the disadvantage of being more liable to corrosion than the other materials mentioned. To protect it against corrosion, a film of watch oil may be used.

Steels containing a high percentage of nickel, or both nickel and chromium, resist corrosion and are non-magnetic. "Invar," which contains 36 per cent of nickel, and "Elinvar," which contains 36 per cent of nickel and 12 per cent of chromium, are the best known of these steels.

Hairsprings made of the non-ferrous alloys are less subject to corrosion than carbon steel, and are also of low electrical resistance, making them especially suitable for certain electrical instruments. For applications requiring high elastic limit and hardness, a spring of higher tin content is used.

Palladium alloys combine incorrodibility with high elastic limit, but owing to their high cost, their application is limited to chronometers.

In applying hairsprings, care should be taken to avoid the necessity for low electrical resistance, because materials of high elastic limit almost always have a high electrical resistance. When it is necessary, however, to have current flow through the spring, hard-drawn phosphor-bronze containing from 1 to 2 per cent of tin is probably the best choice. The addition of cadmium (up to 2 per cent) raises both the hardness and elastic limit, with only a small increase of electrical resistance.

Hardening of Hairsprings

All the materials mentioned here must be treated before they are suitable for hairsprings, because of their low intrinsic elastic limit. Steel may be hardened either by heat-treatment or by cold working. Non-ferrous metals can be hardened only by cold working. Elasticity is impaired more by cold working than by heat-treatment. Recovery of elasticity may, however, be effected by heat-treatment at temperatures usually between 200 and 600 degrees F.

Carbon steel may be quenched in oil at 1400 degrees F.; this is a suitable hardening treatment for hairsprings, giving a Brinell hardness of more than 650. Tempering between 575 and 660 degrees F. gives a Brinell hardness between 520 and 400, which is usually hard enough for hairsprings. The same steel may be hardened cold by drawing it into a wire of circular or elliptical section, which, on rolling, will produce strip of requisite width and thickness.

"Elinvar" must be cold worked. In order to restore the elastic properties impaired by cold working, the hairsprings should be heated to temperatures of from 660 to 1100 degrees F.

Phosphor-bronze should be cold-drawn into wire of circular section, then rolled, and finally drawn to the desired width and thickness. The hairspring will be improved by a low temperature heat-treatment of thirty minutes at 400 degrees F. This can best be done in an oil bath.

Making Coil Springs

The manufacture of coil spiral hairsprings generally involves coiling operations after the requisite hardness and elastic properties have been obtained. This is always true of non-ferrous springs and of cold-drawn steel springs. It is common, however, to coil steel helical springs for chronometers before they are hardened and tempered. To obtain springs of uniform dimensions, allowance must be made for the opening out of the coil after it is removed from the mandrel. The amount of this "expansion" must be determined by experiment.

The uniformity of hairspring strip is most conveniently tested by determining its tensile strength. The strip may be stretched either by applying weights at the end or by pulling against a calibrated spring. Impact must be avoided.

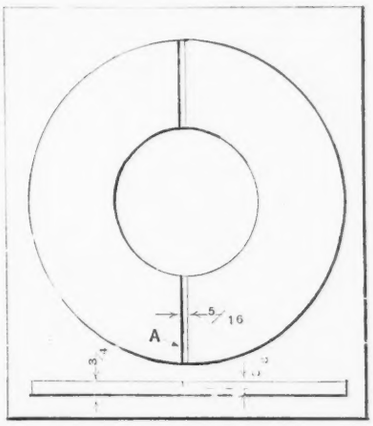
Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

PARTING LOCOMOTIVE HUB LINERS

Various methods are used in railway shops to accomplish the same results, although some are more efficient than others. The writer, having read the article on page 488 of March MACHINERY, showing the manner in which locomotive hub liners are parted, presents another method that has been used successfully for several years.

The ring shown in the illustration is cast with the grooves *A* along which it is parted, after all other machining operations have been completed, by placing it over a wooden block, the edge of which coincides with the grooves. After some experimenting, it was found that with the dimensions given, the ring would easily break along the grooves, the resulting ragged edges producing a desirable close fit when assembled into the hub. By placing the groove next to the driving-box face, a good pocket for the lubricant is provided. This method eliminates the milling operation necessary if the grooves are not cast.



Hub Liner, Showing Cast Groove Along which Break is to be Made

SUPERINTENDENT

HEATER FOR LOCOMOTIVE TIRES

By H. H. HENSON, Foreman, Machine and Erecting Shop, Southern Railway Co.

A heater used for expanding locomotive drive-wheel tires when assembling them on the wheels, is shown diagrammatically in Fig. 1. The details are shown in Fig. 2. This device requires no preheating stove for generating gas from the coal oil used. The fuel is syphoned from a portable tank and forced through a Thermoline valve (made by the Gustin-Bacon Mfg. Co., Philadelphia, Pa.) by compressed air which vaporizes the oil. The vapor passes along through a rubber hose attached at *A* into the generating pipe and thence to the pipe *B*, passing out through the perforations on the inside of the latter, as shown at *C*, Fig. 2. When this vapor is ignited at the holes *C*, the generating pipe becomes heated, causing the vapor to change to a highly combustible gas.

The two pipes are welded together at the points shown in Fig. 2, the shapes of the ends of both pipes being shown at *E* and *D*. A gap is left in the circle to permit the heater to be used without removing the connecting-rods, and the inside diameter of the heater is made 2 inches larger than the outside diameter of the tire.

TOOL FOR MACHINING PACKING RINGS

By E. A. LOTZ, Shop Foreman, Pennsylvania Railroad Co.

In the accompanying illustration is shown a triple tool-holder employed for facing and cutting off

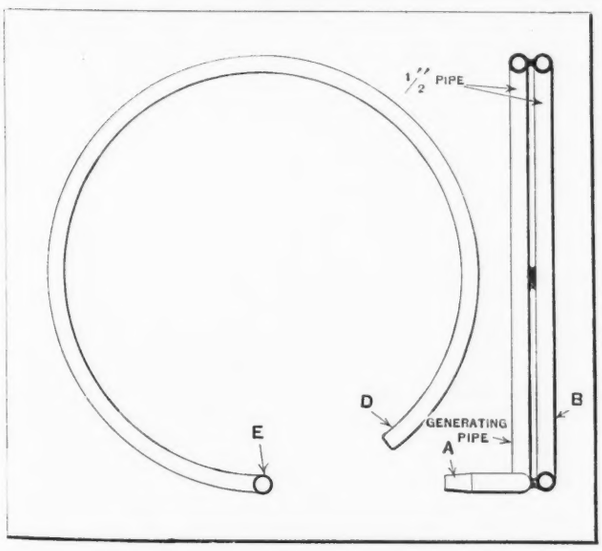


Fig. 1. Tire Heater, which Burns Coal Oil and Operates without a Preheating Stove

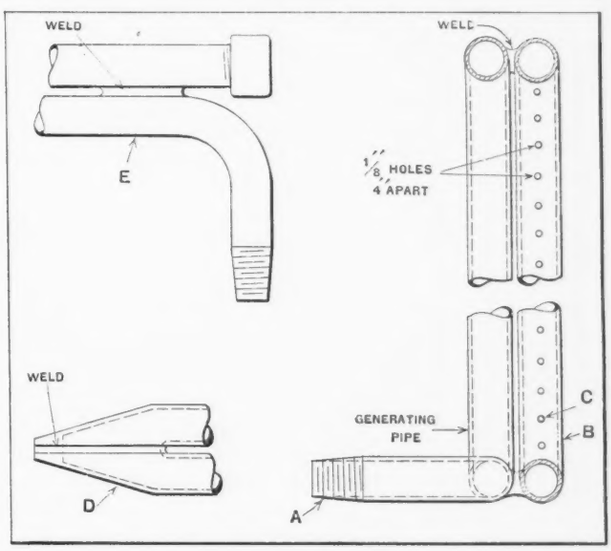
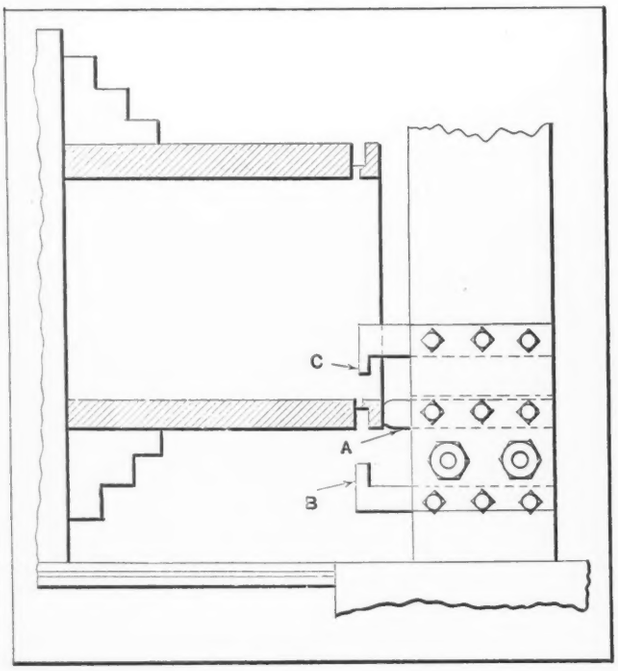


Fig. 2. Details of Locomotive Driving Wheel Tire Heater Shown in Fig. 1



Tool-holder and Special Tools for Machining Packing Rings

locomotive valve snap rings or cylinder packing rings from a cylindrical casting. The adoption of the triple tool-holder resulted in a reduction of 62.5 per cent in the labor cost on this class of work. With this tool-holder it is much easier to hold all rings to the same thickness, as the setting of the tool remains the same after cutting off each consecutive ring.

In machining a ring, the tool *A* first faces the end of the casting, after which the tool *B* cuts the outer groove to the required depth. A reversal of the direction of feed then causes the tool *C* to cut off the ring, after which the operation is repeated. Thus, it is necessary to change the position of the tools only when the wear on their cutting edges is sufficient to show a slight increase in the width of the machined rings.

Ordinarily, several cylindrical castings can be cut up into rings before it is necessary to regrind or reset the tools. Although the tools shown in the illustration are applied to a lathe, the arrangement has been used with equal success on a vertical boring mill for machining both large and small rings.

NOVEL SCORE BOARD PROMOTES SAFETY

By C. W. GEIGER

Several thousand shop employes at the Sacramento (California) shops of the Southern Pacific Co. are enthusiastically interested in a league contest in which the prize is their own safety. During the past year, the shops have engaged in an inter-shop and inter-department safety-first contest in which the scoring scheme of baseball has been adopted as the method of determining the winners. Two large score boards, one of which is shown in the accompanying illustration, have been erected.

On each board is a painted diagram representing a baseball diamond, with the home plate, first, second, and third bases represented in a conventional manner. There are also blackened spaces on which are chalked the current standings of the various clubs that make up the different teams. Round disks, each bearing the name of one of the shop departments or "clubs," are moved from base to base in conformity with their standings, as shown on the score boards.

Each week completed without any accidents entitles a shop to one "hit" and advances the shop's marker on the diamond one base. Four consecutive weeks without an accident credits the shop with a "run." A minor accident is considered an "error," and results in the shop's marker being placed back one base. A major or reportable accident is classed as a "put out" and causes the shop's marker to be returned to the "home plate" where it must start its journey around the bases again.

There are two leagues; one, comprising twenty-seven shops in the locomotive department, is divided into three teams. The other comprises fourteen shops in the passenger car department and is divided into three teams. The passenger car department had but one reportable accident during the first six months after the league was established, and the locomotive department suffered only two reportable accidents during three months' time.

* * *

In 1913, the exports of machine tools from Germany were valued at about $20,000,000. In 1928, the value of German machine tool exports was about $35,000,000. The exports of woodworking machinery in 1913 were valued at about $3,200,000, and in 1928 at about $4,400,000. Steam and hydraulic forging presses, riveting machines, and electric and pneumatic hammers are not included in the figures for machine tools; in 1913, exports of these classes of tools were valued at $700,000; in 1928, they were valued at $1,100,000.

Baseball Type of Score Board for Recording Safety Contest

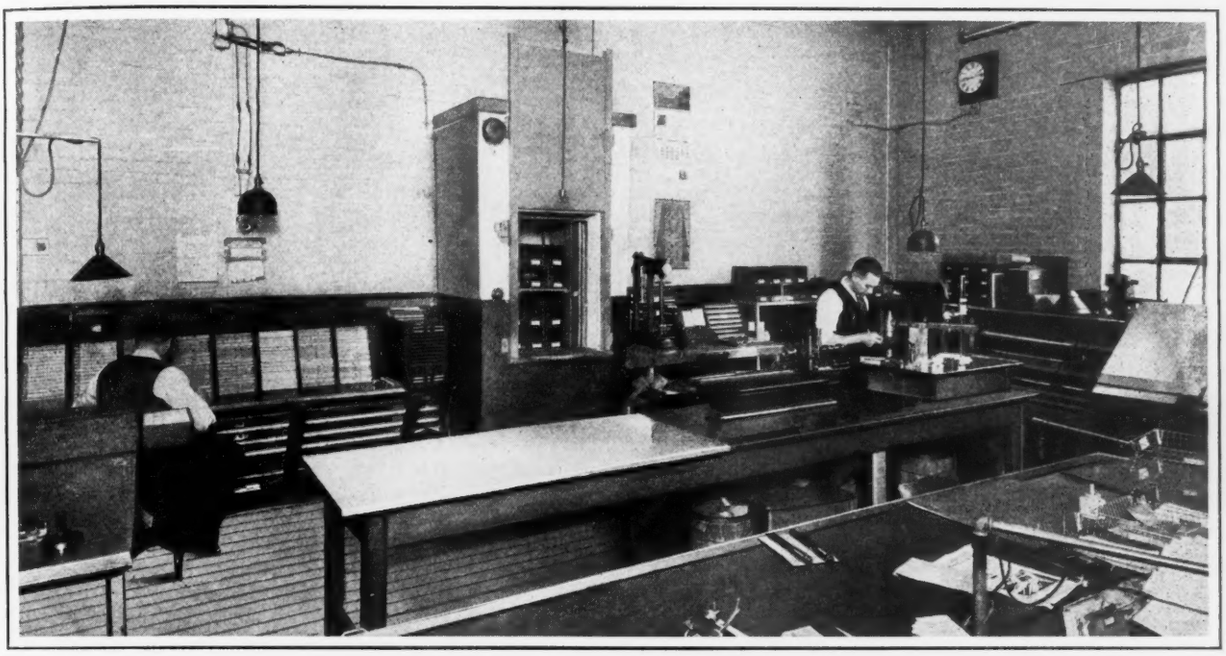


Fig. 1. Tool Inspector's Bench Adjacent to the Delivery Dumbwaiter and the Visible Kardex File

Cutting Costs with a Tool Control System

A Tool Engineering and Control System that has Effected Large Savings in Manufacturing a Wide Variety of Products—Second of Two Articles

By L. H. TENNEY, Tool Supervisor, De Laval Separator Co., Poughkeepsie, N. Y.

SUBSTANTIAL savings in the cost of small tools, jigs, fixtures, etc., and greatly reduced inventories of small tools, constitute two of the important advantages obtained from a tool engineering and control system employed by the De Laval Separator Co., as described in August MACHINERY, page 900. This article gave actual figures of the savings derived through the operation of the system, illustrated some of the forms used, and explained various features of the tool engineering division. The present article will deal with the system as it applies to the activities of the tool manufacturing, tool-crib, and tool record divisions of the company referred to.

Controlling the Work of the Tool Manufacturing Division

Through the use of this tool engineering and control system, the number of men in the tool manufacturing division has been reduced from 60 to 40, a reduction of 33 1/3 per cent, during the first year. The work of these men is controlled by one general foreman, three sub-foremen, a follow-up clerk, and a tool inspector.

The follow-up clerk receives four copies of all tool shop orders (see Fig. 7 of August article) from the record division, and all repair orders from the shop and the tool-crib division. Upon the receipt of material for new tools, the follow-up clerk places buff and pink copies of the tool shop order in a tote box with the material and sends the job to the sub-foreman of the tool-room in charge of that particular class of work. The pink copy of the shop order is placed in a visible file at the station of this sub-foreman, while the buff copy stays with the work.

The yellow copy of the tool shop order, or "progress sheet" as it is called, is placed in the visible Kardex file seen at the left in Fig. 1, which is located at the station of the time clerk in a direct view from the desk of the general foreman. The time clerk, who is under the supervision of the accounting department, transfers all the toolmakers' time from the individual time cards to this visible "progress card" and moves the signals accordingly. Different signals are used; one shows up the due date in three different colors that represent the current month, following month, etc.; another signal shows that a man has been assigned to the job, the color denoting his grade; and still another signal indicates that the job is running over the estimated time at certain stages.

Jobs running over the due date or over the estimated time are also signaled on a visible chart in the record division and, according to the magnitude of the job, the clerk in charge of records notifies the estimator concerned or the tool supervisor.

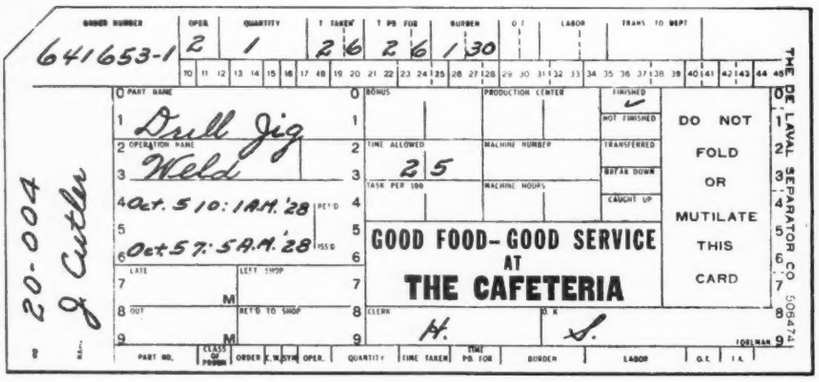


Fig. 2. Time Card Used by the Toolmakers

Time cards of the type shown in Fig. 2 are used by the toolmakers. These cards are punched at the beginning and end of each job.

Requisitions for repairs are made out on the form illustrated in Fig. 3 and sent direct to the tool manufacturing department with the tools to be repaired, by the department or tool-crib requesting the work. Every person writing a repair requisition is asked to enter his estimate of the time that should be spent in doing the work. Emergency repair work is delivered direct to the sub-foreman in charge of that particular class of work. This sub-foreman accepts the job and the estimate or makes a new estimate, which he supplies to the follow-up clerk. It is the duty of the follow-up clerk to report any discrepancies in estimates, promised dates, etc., to the general foreman, and order material from the stores division, if required.

The buff copy of the tool orders serves as a transfer for finished tools and accompanies them to the tool-crib of the department in which the tools are to be used. Upon the receipt of the tools, the manufacturing department foreman signs the stores issue slip (see Fig. 5 of August article), which is filled out to cover the finished tool. This stores issue slip is returned, together with the yellow copy of the tool order, to the record division, where it is kept in a permanent file.

Sub-foremen Responsible for Jobs from Start to Finish

One of the features of the tool manufacturing division is the policy of assigning each job to a sub-foreman who is responsible for the job from start to finish. He supervises the work of men operating lathes, milling machines, grinders, shapers, etc. At one time the machines of the tool-room were grouped according to the class of machine, with a sub-foreman in charge of lathes, another in charge of milling machines, etc. This arrangement, however, resulted in a considerable amount of spoiled work and in failure to get tools out on time. Increased inspection was resorted to without success.

The problem was solved by a reorganization of the department and a slight change in the machine lay-out. The equipment is now arranged in lines

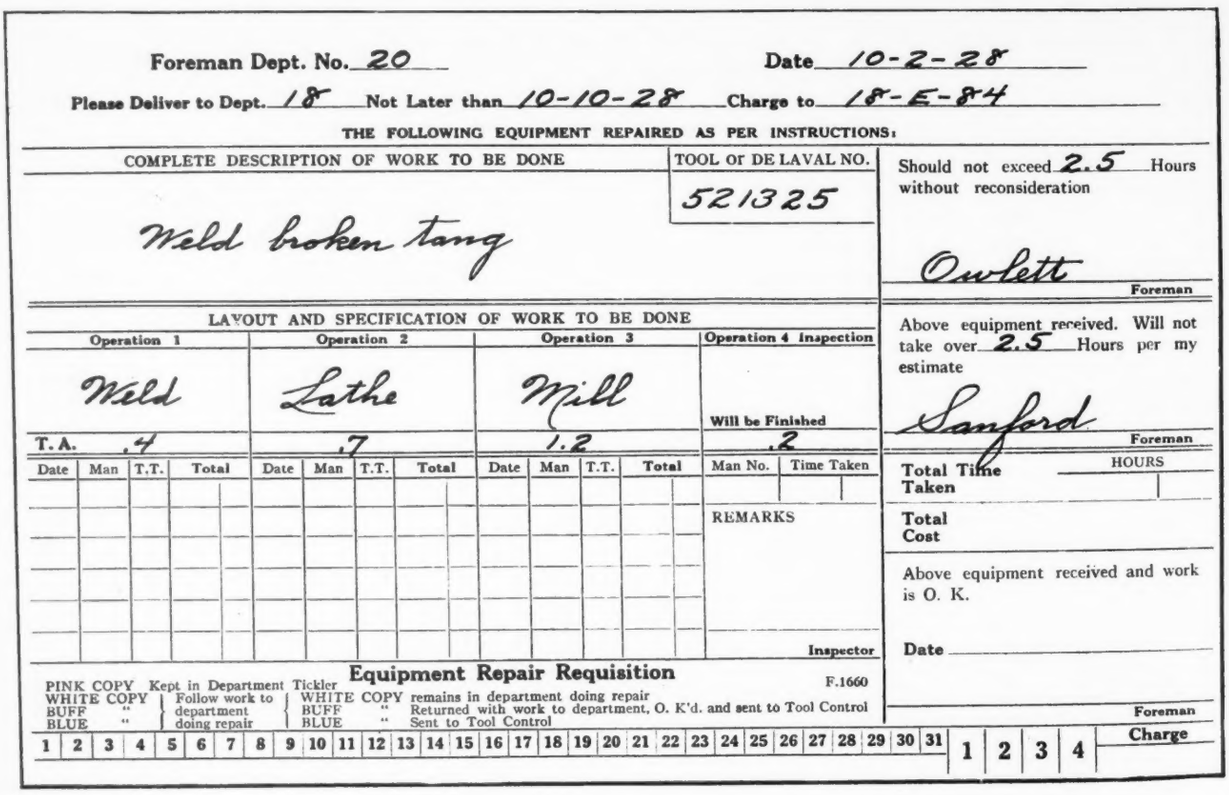

Foreman Dept. No. 20
Date 10-2-28
Please Deliver to Dept. 18 Not Later than 10-10-28 Charge to 18-E-84
THE FOLLOWING EQUIPMENT REPAIRED AS PER INSTRUCTIONS:
COMPLETE DESCRIPTION OF WORK TO BE DONE
Weld broken tang
TOOL or DE LAVAL NO.
521325
Should not exceed 2.5 Hours without reconsideration
Owlett
Foreman
LAYOUT AND SPECIFICATION OF WORK TO BE DONE
Operation 1
Weld
T. A. .4
Operation 2
Lathe
.7
Operation 3
Mill
1.2
Operation 4 Inspection
Will be Finished
.2
Date Man T.T. Total
Man No. Time Taken
REMARKS
Inspector
Above equipment received. Will not take over 2.5 Hours per my estimate
Sanford
Foreman
Total Time Taken
HOURS
Total Cost
Above equipment received and work is O. K.
Date
Foreman
Equipment Repair Requisition
F.1660
PINK COPY Kept in Department Tickler
WHITE COPY Follow work to department doing repair
BUFF "
BLUE "
WHITE COPY remains in department doing repair
BUFF " Returned with work to department, O. K'd. and sent to Tool Control
BLUE " Sent to Tool Control
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
1 2 3 4
Charge

Fig. 3. Requisition for Repair Parts Supplied to the Tool Manufacturing Division by Manufacturing Departments throughout the Plant

running from north to south, according to the classes of machines, and from east to west, according to the classes of work. Fig. 4 shows a view of the second floor of the tool department, looking north from the office of the foreman in charge of manufacturing. It will be noticed that the daylight comes direct from windows on the west side over the benches and the workmen's right shoulders directly into the chucks of the lathes. The same is also true of the lines of milling machines and grinders on the east side of the building.

With a sub-foreman responsible for each class of work from the time it is started until it is put to its intended use, incorrect work has been reduced to a minimum. One inspector takes care of all work of the department, and jobs are finished at least approximately on schedule.

The tools are heat-treated in a room adjacent to the main tool-room. In this department, there are five electric furnaces and five gas furnaces, provided with automatic control and recording equipment.

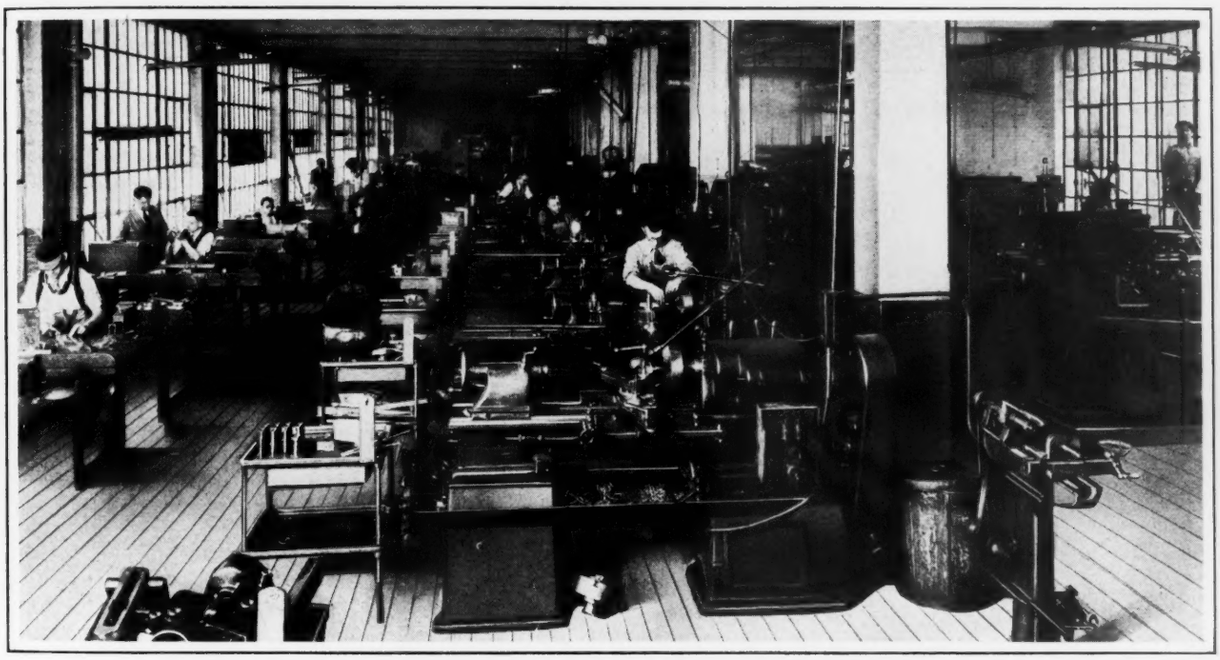


Fig. 4. View of the Tool Manufacturing Division, Showing the Arrangement of Machines According to Type

Tools Carefully Inspected upon Completion

All small tools, such as reamers, taps, broaches, etc., are inspected when finished, and transferred to the particular tool-crib specified on the tool shop order. Major tools, such as jigs, fixtures, punches and dies, in addition to being carefully inspected, are set up, tried out, and proved satisfactory before orders are closed. In Fig. 1 the inspection bench of the tool department may be seen at the right. The dumbwaiter that delivers parts to the master crib and material stores and to the follow-up clerk, is seen in the middle of the illustration.

How the Tool-crib Division is Organized

The tool-crib division consists of a central crib where all new tools are received and inspected, and sub-cribs that serve each manufacturing department. A part of the central crib is shown in Fig. 5, while Fig. 6 shows a sub-crib. Tools used by more than one manufacturing department are stored in the central crib, one section being set aside for such equipment. Another section of the central crib is assigned for tools to be salvaged, and a third for tool-steel bar stock and machines for cutting up these supplies. In a fourth section, general tool grinding is done and repairs are made. A supervisor is responsible for the entire crib system. His headquarters are in the central crib, and he is assisted by one attendant and one grinding machine operator in each crib.

When this tool control system was developed, it was found desirable to adopt a new system of numbering tools, principally for classification purposes. A six-digit number is used for all tools, the first denoting the main class; the second, sub-division one; the third, sub-division two; etc. The general scheme is to locate all similar tools together in the cribs and on the records.

Functions of the Tool-crib Division

It is the duty of the tool-crib division to receive and store all tools made or purchased for any manufacturing department, to maintain stocks of these tools and keep them in good condition, and to supply them to the manufacturing departments as required. The tool-crib division is also responsible for keeping the tool engineering division informed if tools are used that are not in accordance with the tool list (see Fig. 17 of first article). To facilitate this service, the tool location card (see Fig. 15) is sent to the central crib whenever an order is placed for a new tool to be manufactured or purchased, and the tool list is also furnished after the first order of parts has been run through.

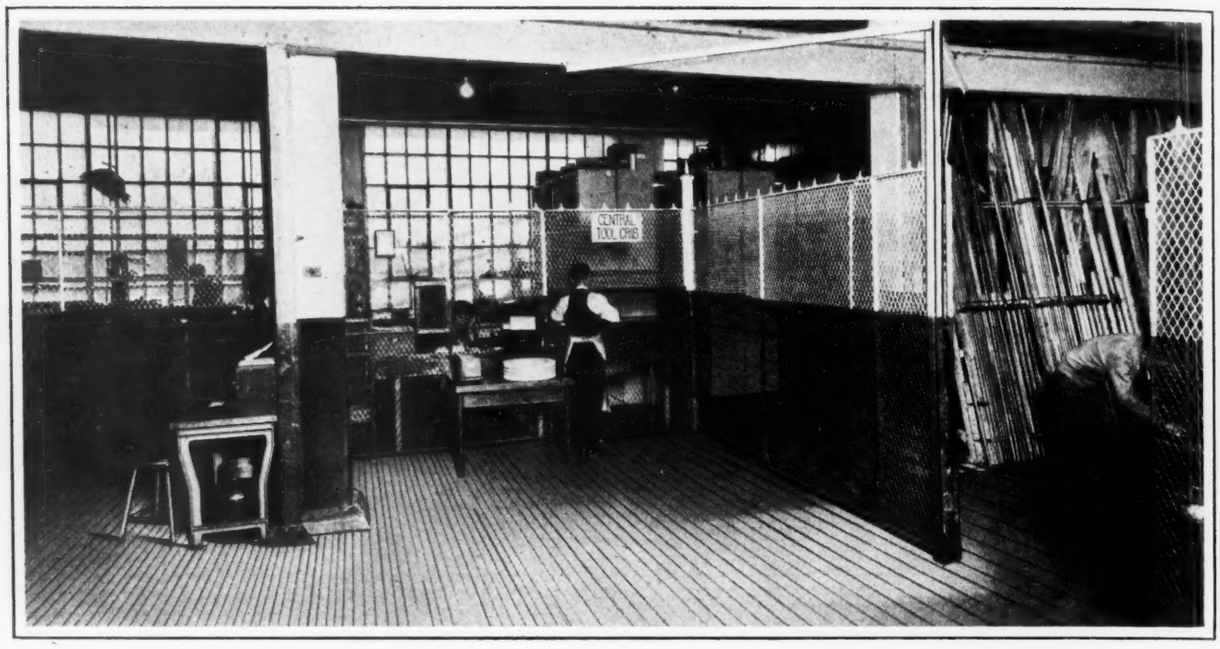


Fig. 5. View of the Central Tool-crib, Showing the Portion Set Aside for Tool-steel Stock

The tool location card is placed in a vertical file at the crib window, according to the tool number, while the tool list is filed in the same cabinet according to the part and operation number.

The lay-out clerk in any department to be supplied with tools fills in, on the form shown in Fig. 7, the name and number of the operator desiring tools, as well as the job number. This slip is handed to the crib attendant as an advance notice that the operation indicated will be started at a given time. Upon receipt of the notice, the crib attendant collects the tools according to the tool list and places them in a container, ready for the operator. When the latter calls for them, he is asked to sign this form, which is then filed in place of the tool list, and the latter is filed according to the number of the man. In special cases, tools are delivered to the operating point by a messenger.

How Changes in Tool List are Handled

An important point of the control system is that each operator, before he receives tools, must give

Fig. 6. General View of a Tool-crib Situated in a Manufacturing Department of the Plant

the number of the part he is going to work on and the operation to which he is assigned. Also, tools are furnished according to the tool list unless otherwise specified by the foreman. When such an occasion arises, the crib attendant fills out a tool change notice, such as shown in Fig. 8, and forwards it to the tool engineering division. There the master tool list (see Fig. 10 of first article) is changed accordingly, unless there is a question as to the advisability of the change, in which case the foreman of the manufacturing department is first consulted.

PART SLEEVE NO. 10885 OPER. BORE AND FACE NO. 1
TO START 9-10-28 MAN'S NAME BAIRD NO. 18-028

The **above** will be filled in by **Layout Clerk** in advance and handed to **Crib Attendant** who will have all tools as per **Tool List** ready to serve in one container to **Operator** who will **Sign** below. This check will be **Filed** in place of **Tool List** which will be moved to **Man No. File** until return of Tools. **Add Extra Tools** below **Not** on **Tool List.**

572304 CHUCK
631112 JAWS

The above **Tools** are **Charged to Operator** _____ **Date** _____

Detroit F.1675 **Tool List Notice and Check** Printed in U.S.A.

Fig. 7. Form Used by Lay-out Clerks of Manufacturing Departments to Advise Crib Attendants to Prepare Tools for a Job

Tools Returned to Cribs are Carefully Examined

It is the rule that every tool must be carefully examined when it is returned to a tool-crib, and repaired or sharpened, if necessary, before it is again stored. Extra tools are carried in stock and kept sharp for jobs that run steadily or that require the tools to be ground more than once per lot of parts. As operators are not permitted to sharpen tools, dull tools are turned in to the tool-cribs for sharp ones.

Stocks Maintained of Small Tools

Stocks are maintained of all small tools that are used enough to warrant this practice. To control these stocks and insure a minimum quantity at all times sufficient to allow time for replacements, a maximum balance, order point, and danger point are established for each class of tools stocked. The order point is recorded on the bin label (see Fig. 14 of first article), and the same information is on file in the record division on the change-in-order-points slip shown in Fig. 9 and on the balance card illustrated in Fig. 10. These forms serve as a check against crib attendants in case they permit stocks to fall below order points. The number of tools in a bin or drawer plus the checks held against workmen should always be equal to or more than the order point.

The danger point is established on tools having a high usage, and is the lowest quantity it is safe to carry. A red tape is tied around this quantity and when the tape is cut, an order is placed. Broken or worn-out tools must be returned to the tool-cribs before workmen can get tools to replace them, except in special cases, and then it is necessary for a workman to have an order from his foreman.

Scrap tickets (see Fig. 8 of first article) are made out in duplicate by crib attendants for broken or worn-out tools, and sent to the central crib. The tools are held there until finally disposed of, either by reclaiming or scrapping. Then the original form goes to the record division to adjust the balance card, Fig. 10, of the tool scrapped. The duplicate is sent to the same department to adjust the balance card of the tool into which any part has been reclaimed. Tools that become obsolete, due to the discontinuance of parts for which they are intended or to changes in operations and methods, are reclaimed or scrapped, and their records follow the same procedure as that outlined.

Detroit F.1648 **Notice of Change in Tool Records** No. D-107

Reason	Old T No.	Old R No.	Old Drawing No.	New Drawing No.
Addition Part No.	—	—	—	—

NEW TOOL NO. 572304
MAIN SIZE: _____ m/m.

Used in Dept.	Inv. in Dept.	Max. Bal. Allowed
18	1	1

USED ON PART NO. AND FOR OPERATION NO.

Part No.	Op. No.	Part No.	Op. No.	Part No.	Op. No.
10885	1				

Charge: Plant Expense
Pattern No.
Checked by R.L.
DESCRIPT. OR REMARKS: Chuck used to hold Sleeve while boring and facing.
DATE 9-10-28
Signed J. Isett

TOOL NO. Assigned	TOOL NO. Entered	Old T or R No. Index	Drawing Changed	F1625	Balance Card	Manufact. Order	Spec. Card	Location Card	O. P.	Part No. Index	Tool Re-stamped
N			—								
C			—								

Fig. 8. Slip Used by Crib Attendants to Inform the Tool Engineering Division of Tool Changes

Reclaiming Tools for Operations Other than Those for which They were Originally Designed

Worn-out or scrapped tools considered fit to be reclaimed are classified and stored in separate bins until occasions arise when they can be used. All requisitions

for new tools pass the crib supervisor, who decides whether or not old tools can be reclaimed for the service intended; this practice often obviates the making or buying of new tools. When a recommendation for reclaiming an old tool is approved by the tool supervisor, the requisition is stamped "Reclaim" and filed. A card is then sent to the central crib by the tool engineering division as authority for reclaiming the old tool, the scrap and replacement ticket before mentioned serving as a transfer slip and furnishing information for the balance card shown in Fig. 10 when the tool is finished.

STOREROOM 4 7T PART NO. OR SYMBOL S 421121

NAME Drill, T. S. - H. S. (12.302 m/m)

(Above Lines to Contain Full Bin Label Description)

SPECIFICATION 31/64"

PRESENT	DANGER POINT	ORDER POINT	AMT. TO ORDER	TIME REQ.	UNIT
PROPOSED		3	12	4wks.	Ea.

USED 192

REASON To establish stock in 47T.

DATE 12-10-28 SIGNED

Stock Above O. P. or New Order Issued	Sp. Or. Pts. Changed or Pur. Time All.	Bin Label	S. R. D. Cards	Specification Cards		Layout & Charts	Time Study
				Plan. Dpt.	Pur. Dpt.		
		Blue XX AP					

Reveral F 1114 CHANGE IN ORDER POINTS Printed in U.S.A.

Fig. 9. Slip Filed in the Record Division to Cover Information Relating to Stocks of Tools

To eliminate unnecessary bookkeeping in maintaining records of costs involved in reclaiming tools, it was decided to issue a blanket order for each general class of reclaimed tools, numbering the classes 100,000, 200,000, etc., and to make a flat charge of 50 per cent of the cost of a new tool. To determine the success of this practice, the reclaiming division is credited with the amount of these charges for every month on each class of tools, and charged with the actual cost of the time turned in for doing the work. No attempt is made to find the cost of each individual tool, although the details could be readily tabulated from the time cards should it be desirable to do so. Figures concerning the reclamation of tools show that the total cost of reclaiming tools each month is slightly under the 50 per cent charged.

Responsibilities of the Tool Record Division

The tool record division is responsible for all records pertaining to tools. It issues all tool numbers upon requests received from the engineering division; issues all manufacturing orders for tools made in the plant, upon the receipt of approved requisitions; and keeps a tickler file and progress record of tools being made. It also makes out slips for all material used on tool orders, as per specifications received from the engineering division; issues numbers and specifications to the purchasing department for all tools to be purchased, upon receipt of approved requisitions; and keeps a tickler file of such orders.

Balance cards, such as shown in Fig. 10, are kept by the department for all tools made or purchased, and on these cards are recorded the quantities of tools received and issued from stock. The record division is also responsible for reminding tool-crib attendants when orders for the replenishment of tools are not placed as order points are broken. The division also records the condition of stocks on every requisition sent to the tool supervisor for approval. Balance cards and records are maintained for all materials used in making tools.

TOOL NO. 641653 P.O. or ORDER NO. -1 DESCRIPTION Drill Jig REQ. NO. PRICE UNIT CARD NO. 1

Received 19 28		Balance on Order	Issued 19			Balance on Hand	Dept. 18 Max. 1			Dept. Max.			Dept. Max.			Misc. Depts.		
	Quantity			Charge	Quant.		Date	Scrap	Bal.	Date	Scrap	Bal.	Date	Scrap	Bal.	Date	Scrap	Bal.
8-31		1						Inv.	0									
	10-8-28			18 Plant														

Withdrawal from Stores	Reclaimed Tools		New Tools		USAGE IN DEPARTMENTS							
	19	Current Year	19	Current Year	19	Current	19	Current	19	Current	19	Current
Previous Card												
This Card												
TOTAL												

Fig. 10. Balance Card Filed in the Record Division to Show the Number of Tools Placed in Stock on Various Orders, the Number Issued to the Shop, and the Quantity on Hand

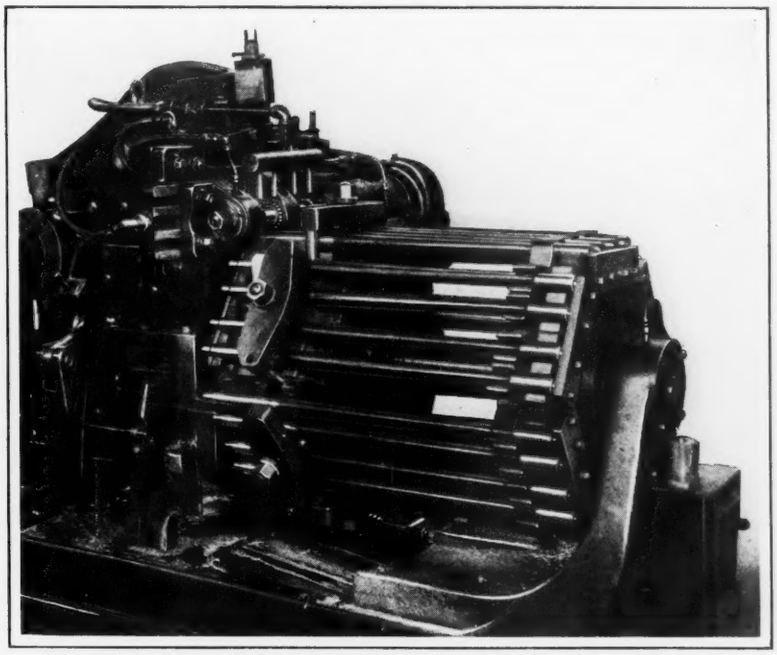
Other activities of the record division include the tabulating and recording of all labor, burden, and material costs chargeable to tool orders; the keeping of all records on closed orders; and the reporting of the value of tool orders closed each month. A cross-index record is maintained for each tool, with respect to the part it is used on, this information originating on the advance tool list (see Fig. 1 of first article). The information must be verified each time that a requisition is issued for a new tool. This record serves as a duplicate and master for the location cards and regular tool lists furnished to the tool-cribs.

A record is kept of estimated and actual hours of work in the tool-room, which serves as an efficiency check on the department as a whole, as well as on each man. It also serves to show the number of hours of work ahead of the tool-room, against the hours available. Monthly reports are made up of tool orders closed and their estimated and actual costs.

The tool record division is a branch of the factory accounting division, and it is responsible to the latter for accurate values and inventory reports, although most of its service relates to tool administration.

MILLING KEYWAYS IN REAR-AXLE SHAFTS

Keyways are milled simultaneously in the tapered end of four rear-axle shafts at the Plymouth automobile plant of the Chrysler Corporation, Detroit, Mich., by employing the machine here illustrated. This machine is equipped with a six-sided fixture, and four axle shafts can be mounted on each side. In operation, the cutter-head advances, carrying forward four milling cutters which mill the four axle shafts in the upper position of the fixture. Upon the completion of each group of shafts, the fixture indexes automatically, bringing four new shafts in line with the cutters. The keyways are cut to a length of 2 1/2 inches, a width of from 0.3115 to 0.3135 inch, and a depth of about 5/32 inch. The production averages 100 axle shafts per hour.



Automatic Machine which Mills Keyways in Four Axle Shafts at Each Indexing of a Six-sided Fixture

* * *

A. S. M. E. NOMINATES OFFICERS FOR 1930

The nominating committee of the American Society of Mechanical Engineers has nominated Charles Piez, Chairman of the Board of the Link-Belt Co., Chicago, Ill., as president of the Society for 1930. Among the nominees for vice-presidents is Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt.; and among the nominees for managers are Harold V. Coes of Ford, Bacon & Davis, industrial engineers, New York City, and James D. Cunningham, president of the Republic Flow Meter Co., Chicago, Ill.

COST OF OPERATING AUTOMOBILES

The Engineering Experiment Station of the Iowa State College has made a thorough study of the operating costs of automobiles, which is considered the most exhaustive investigation made on this subject. Considering all expenses, including depreciation, it is estimated that, on the average type of road, the operating cost varies from 6 cents per mile for a light four-cylinder car to 9.45 cents per mile for a heavy six-cylinder car. The influence of different kinds of roads on operating cars is indicated by the fact that the cost of operation on the best kind of roads is reduced to 5.1 and 8 cents per mile, respectively, for the types of cars mentioned, while on poor roads it is increased to 7 and 11 cents per mile. Good roads save the car-owner's money.

* * *

INDUSTRY AIDS IN STANDARDIZATION

A total of 102 simplified practice recommendations have been settled upon by American industries, working in cooperation with the Bureau of Standards. The report covering the activities of the Commercial Standards Department of the Bureau of Standards has just been published, calling attention to the results of the work carried on up to the present time. Some 21,500 trade associations and firms have signified their willingness to support the various simplification programs undertaken in their respective fields.

BORING OPERATIONS WITH DIAMOND TOOLS

The extent to which diamond tools are used in production work is indicated by a report of the Society of Automotive Engineers' sub-committee on processes and equipment, prepared by G. W. Blackington, chairman of the committee. The report is based on answers to questionnaires sent to motor car manufacturers, aeronautic engine manufacturers, and makers of machine tools, heavy machinery, and electrical machinery.

Most of the information secured is given in Table 1, which shows the practice followed in boring the large and small ends of connecting-rods, when machining bronze bushings in cluster gears used in the transmission. Two bushings in this cluster are machined simultaneously by two diamond tools. The diamonds are set in 1/4-inch and 3/8-inch diameter tips held in boring-bars running in bearings.

The Stutz Motor Car Co. of America reported that 2000 connecting-rods are finished per diamond. The International Motor Co. states that its cutting is done at low speed, because of the equipment used, and the diamond expense is very low.

Nearly all the manufacturers describe the diamond tools as being of the round-nose type. The

Table 1. Boring Connecting-rods with Diamond Tools

Factory	Large End, Babbitt					Small End, Bronze					Data Applying to Both Ends		
	Diam., Inches	Cutting Speed		Feed per Revolution, Inches	Single Depth of Cut, Inches	Diam., Inches	Cutting Speed		Feed per Revolution, Inches	Single Depth of Cut, Inches	Parts per Hour	In Use, Years	Lubricant*
		R.P.M.	F.P.M.				R.P.M.	F.P.M.					
Cadillac	2.376	1750	1088	0.0015	0.010	0.8746	3500	802	0.00075	0.005	45	3 1/2	S
Continental	.....	....	....	.....	.....	0 735	3600	....	0.0015	0.0015	120	1	G
Ford	.....	....	....	.....	.....	0.993	3100	....	0.036	0.0075	360	1/6	S
Graham	2.125	2200	....	0.0016	0.007	....	....	....	.....	.....	136	1	O
Hupp	2.125	1850	1029	0.0023	0.007	0.985	2900	902	0.0013	0.007	100	1	M
La France	2.2520	1725	1016	0.0125	0.011	.....	....	....	.....	.....	80	New	None
La France	.....	....	....	.....	.....	1.250	1725	565	0.0125	0.007	90	New	None
Lycoming	2.125	2000	....	0.0028	0.0055	.....	....	....	.....	.....	90	1	S
Mack	2.375	1300	810	0.0051	0.017	.....	....	....	.....	.....	22	6	C
Nash	2.250	1600	....	0.0025	0.010	0.9275	2850	....	0.0025	0.003	84	1 1/2	O
Packard	2.189	1527	875	0.0018	0.010	0.8755	3054	700	0.0009	0.003	70	5	S
Stutz	2.377	500	308	0.0025	0.005	0.8748	500	115	0.0025	0.005	17	2	O
Wilson	2.000	1780	932	0.0014	0.0065	0.7968	3300	688	0.0076	0.0035	59	2	C
Wright	1.182	3200	....	0.001	0.0035	0.875	3200	....	0.001	0 0035	50	1/6	S
Coulter	2.000	1000	1000	0.004	0.005	1.000	4000	1000	0.002	0.005	120	2	C

Machinery

*G = Grinding compound; M = Mineral lard oil and soda water; O = Oil; S = Soluble oil; C = Compound.

and in Table 2, which contains data on boring operations on crankcases and other parts. No definite data on turning operations was received.

It is hardly possible to draw definite, general conclusions from the tables, but they will doubtless serve as a guide to production men contemplating similar applications.

Very little definite information was obtained on the cost and life of diamond tools. The Nash Motors Co. reported that the average life of its tools was two months when used in cutting babbitt, 1 1/2 months when cutting bronze, and two years

Graham-Paige Motors Corporation report using a shape similar to a broad-nosed lathe turning tool having a back rake and front cutting clearance. Square-nosed tools are recommended by the Automatic Machine Tool Co., builder of automatic diamond-tool boring machines.

Soluble oil seems to be most generally used as a cutting compound or lubricant. The possibility of holding dimensions within very close tolerances is illustrated by the practice of the Packard Motor Car Co., which holds both bores of the connecting-rod within a tolerance of ± 0.0001 inch.

Table 2. Boring Miscellaneous Parts with Diamond Tools

Factory	Kind of Work Machined	Diam., Inches	Cutting Speed		Feed per Revolution, Inches	Depth of Single Cut, Inches	Parts per Hour	In Use, Years	Lubricant*
			R.P.M.	F.P.M.					
Mack	Piston-pin hole in piston.....	1.4375	1340	505	0.002	0.008	28	6	C
Coulter	Piston-pin hole in piston.....	1.000	4000	1000	.....	.....	100	1	C
Mack	Main bearings†	2.932	125	96	0.006	0.0025	4	6	None
Cadillac	Main-bearing bores in crankcase, aluminum	2.812	1680	1236	0.0013	0.0075	14	1 1/2	None
Cadillac	Camshaft-bearing bores in crankcase, aluminum	2.625	1750	1203	0.00125	0.005	14	1 1/2	None
Packard	Camshaft rear-bearing, cast iron...	1.375	1600	576	0.0013	0.005	30	3	K
Nash	Transmission Cluster-gear bushing, bronze	0.990	1700	....	0.0025	0.0025	27	2 1/2	None
Nash	Reverse gear	0.990	1700	....	0.0025	0.0025	35	New	None
Packard	Shaft bearing in shock-absorber housing, bronze	1.000	3300	864	0.0005	0.008	80	2/3	S

Machinery

*C = Compound; K = Kerosene; S = Soluble oil. †These bearings are of progressive sizes, the largest being 2.969 inches in diameter.

Converting Chips into Real Profits

The Unusual Chip Disposal System of the Packard Motor Car Company has Many Advantages

By CHARLES O. HERB

CAST-IRON chips are a source of considerable annoyance in many shops where castings are machined in large quantities. Operators are obliged to brush the comparatively heavy chips from their machines in order to keep tools and fixtures clean; sweepers are necessary to keep the floors tidy; men and trucks must be employed to take the chips from the machines and departments; large, space-consuming bins are required for storing the chips until the accumulation is sufficient for disposal in truck or carload lots; and sales effort must be expended in finding customers for the chips. Furthermore, the powdery nature of the chips prevents their use in large quantity in any one charge of a foundry cupola, and results in a high melting loss, as well as oxidation.

These inconveniences have been practically eliminated at the plant of the Packard Motor Car Co., Detroit, Mich., through the installation of chip disposal equipment that will be briefly described in this article.

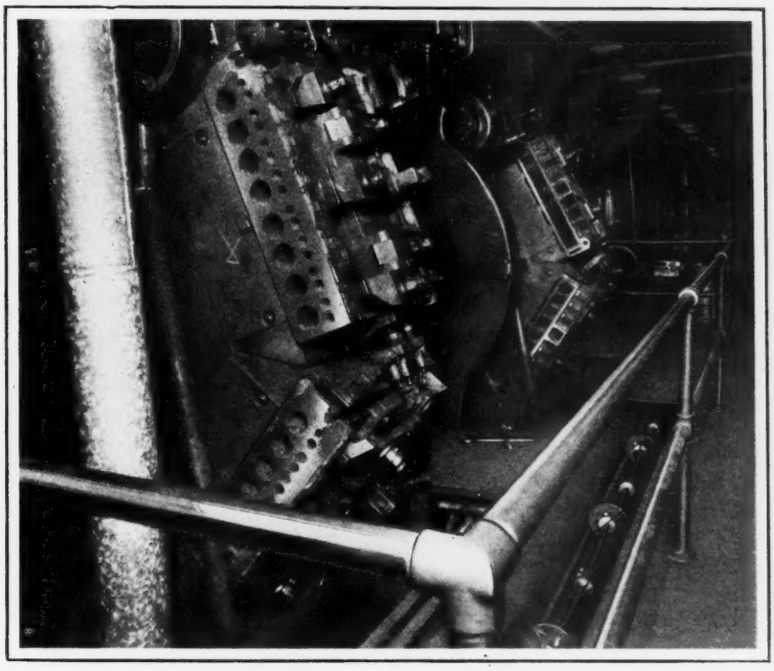


Fig. 1. Conveyors Installed beneath the Floor of the Cylinder Department, as Shown, Carry Away all Chips from the Machines

Hidden Conveyors Carry Chips from the Cylinder Department

The bulk of the cast-iron chips is produced in the cylinder block and cylinder head departments, which are arranged beside each other. (An article outlining features of the cylinder block department will appear in a coming number of MACHINERY). In both these departments a conveyor beneath the floor carries all chips away from the machines as they are produced. Fig. 1 shows one of these conveyors passing in back of two drum-type continuous milling machines, several steel floor plates having been removed when the photograph was taken. The conveyors are covered for their entire length by these floor plates, which can be lifted at any point to give ready access to the conveyors.

All the machines that take heavy cuts are provided with chutes that carry the chips as they are produced directly to the conveyors. At other machines where comparatively light cuts are taken, the chips are brushed to the floor and swept periodically on certain of the floor plates having grated openings through which the chips drop into the conveyor trough. Thus it will be obvious that in the cylinder block and cylinder head departments chips are disposed of without the use of trucks or extra manual labor.

Iron castings are also finished on the third floor of the building in which the cylinder block and cylinder head lines of machines are installed. The chips from this third floor department are taken in wheelbarrows from the machines to one of two chutes leading to the conveyor that extends along the machines of the cylinder block group. One of these chutes may be seen at the left in Fig. 1.

Briquetting Machine Compresses the Chips into Cakes

The conveyors just described carry the chips to the large overhead bin partially visible in Fig. 2, and from this bin quantities of the chips are permitted to drop every so often into the hopper of the briquetting machine seen at the left. At each return stroke of this machine the chips are allowed to fill a cylinder about 15 inches long and 2 3/4 inches in diameter. Then, on the next forward stroke of the ram, the chips are compressed into briquets of the same diameter and 2 1/2 inches in length, weighing about 2 1/2 pounds. These briquets are forced together so tightly that they do not break when thrown on a concrete floor.

On the return stroke of the ram, the briquets fall into a chute which carries them to the vertical conveyor shown enclosed at the right of the machine. This conveyor discharges the cakes into trucks of the construction shown at the extreme right, which are hauled in trains by an electric truck direct to the foundry, where they can be dumped with ease.

Twelve tons of chips can be handled per nine-hour day by this briquetting machine, which was built by the Southwark Foundry & Machine Co., Philadelphia, Pa. The machine is motor-driven and has an air-operated cylinder which compensates for any variation that may occur in the amount of chips entering the compressing cylinder or die. Small pieces of metal, such as tool bits, that may accidentally reach the briquetting machine, are automatically separated from the loose chips.

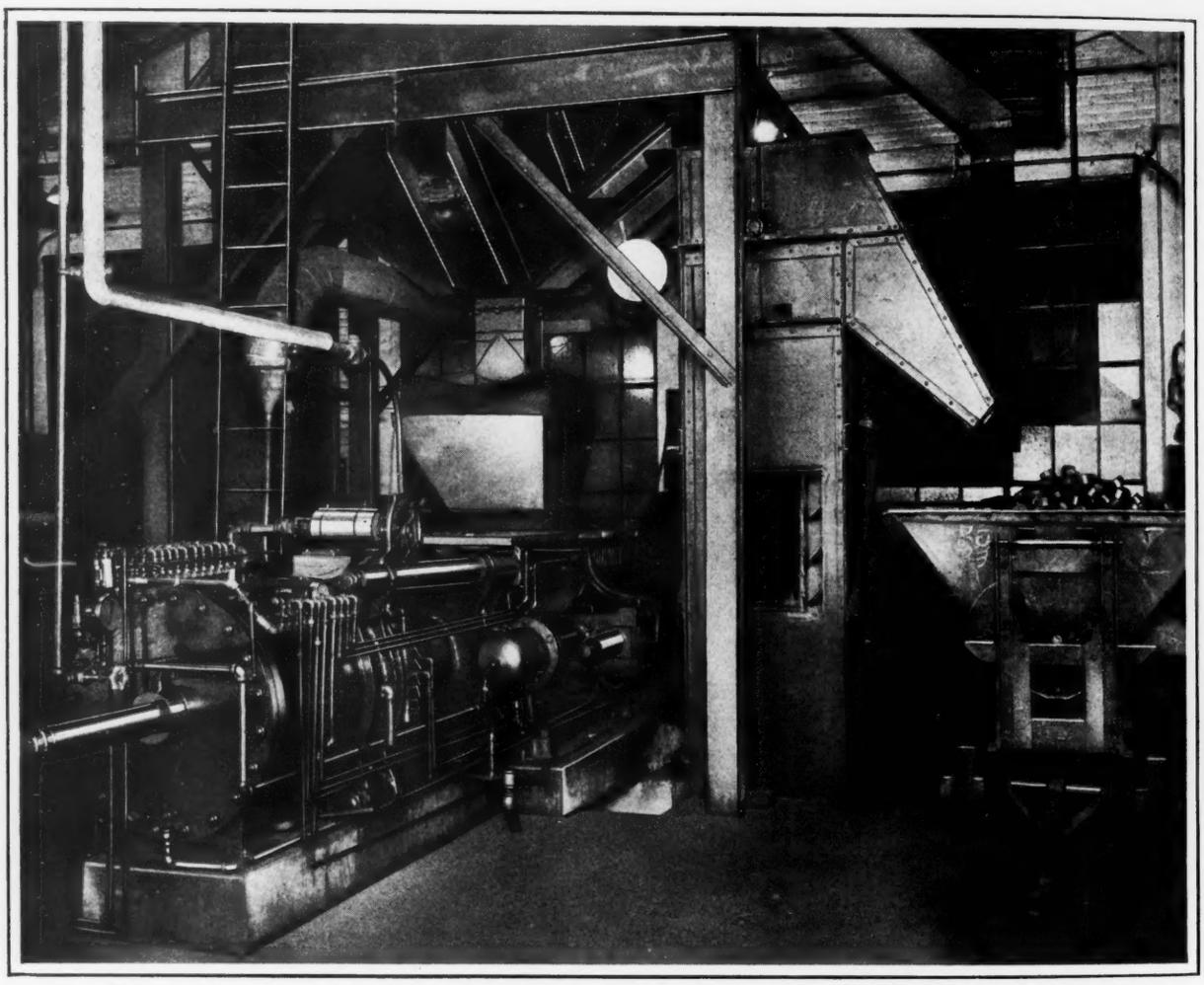


Fig. 2. A Briquetting Machine Presses the Cast-iron Chips into Small Cakes for Charging into Foundry Cupolas

How the Equipment has Proved Profitable

Briquetting the chips greatly reduces the trucking that would otherwise be necessary in transporting them from the plant, because of the tremendous reduction in bulk; however, a far more important advantage is derived from this practice. Before the briquetting machine was installed, the concern sold the chips at prices that gave only a slight profit on the salvaging, and purchased cast-iron scrap on the open market for use in the foundry, whereas now large quantities of the briquets can be charged at one time into the foundry cupolas, in fact, up to 10 per cent of the total charge. This results in a large saving in money, and in addition, the analyses of castings produced in the foundry can be more closely regulated than when iron scrap from unknown sources was used, because the analysis of the metal in the briquets is fully known. Another advantage is that the briquets can be conveniently handled at the foundry by magnets and conveyors.

Surplus briquets are readily disposed of to other foundries at prices per ton much higher than are obtainable for loose chips. The additional income derived from this source alone makes the investment a profitable one, as the cost of briquetting is comparatively low. The actual return on the money invested in the briquetting machine is 86.2 per cent.

* * *

An air mail system to cover the whole of China has been planned by the Chinese Government, according to an announcement made by the Department of Commerce.

Letters on Practical Subjects

ADJUSTABLE WORK-SUPPORT

On many occasions, the writer has found it necessary to provide adjustable work-supports to supplement the solid stops of a fixture, in order to prevent the work from springing away from the tool while being machined. The addition of auxiliary supports is particularly desirable in the case of jigs and fixtures for thin cast parts.

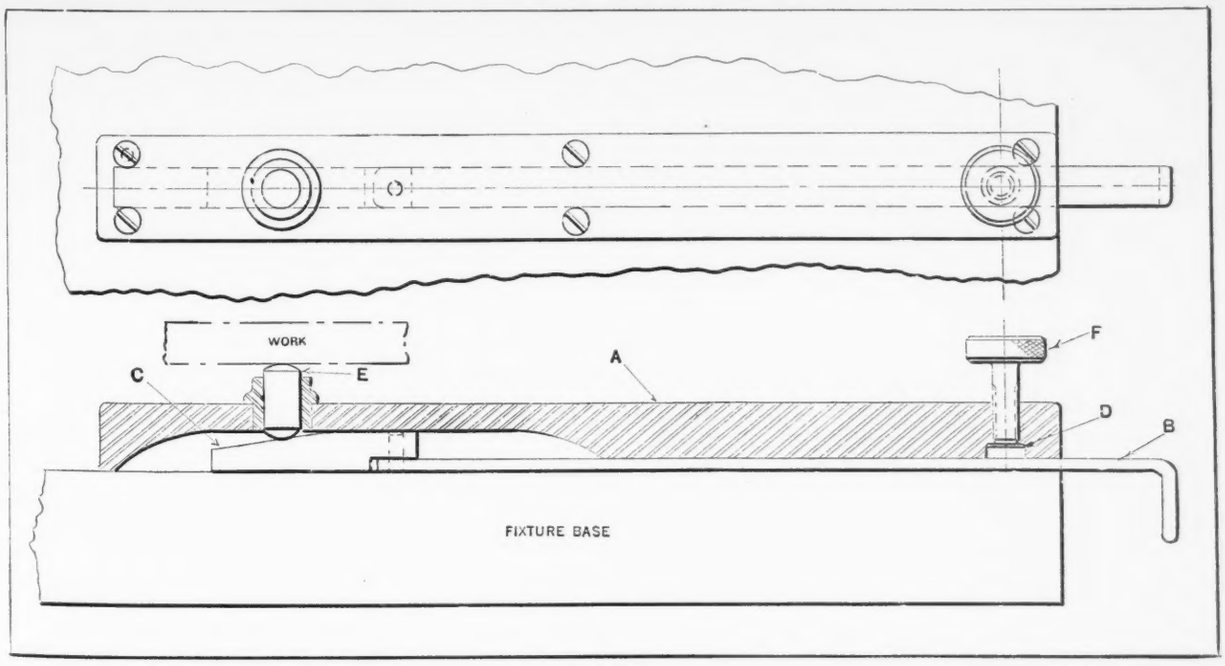
After trying adjustable supports of various designs, the one shown in the accompanying illustration was adopted as being the most satisfactory. It is easy to operate, economical to make, and is readily adaptable to fixtures or jigs of any design. For ordinary requirements, the bar *A* is made from 5/8-inch by 1-inch square edge cold-rolled steel with a slot milled out to receive the sliding member *B*. This bar is cut off to the desired length and secured in place by fillister-head screws. The part *B* is made from cold-rolled stock, 3/8 inch wide by 1/8 inch thick, with the outer end bent down at a right angle to serve as a handle. The pin-hole in the opposite end of part *B* engages the pin in the hardened tool-steel wedge *C* which actuates the work-supporting pin *E*.

The upper face of wedge *C* is finished to an angle of 7 degrees. After the work is clamped in the fixture, the work-supporting pin *E* is brought in contact with the under side of the piece by pushing the handle *B* forward. The knurled-head screw *F* is then tightened to prevent the wedge *C* from slipping back while the machining cut is being taken.

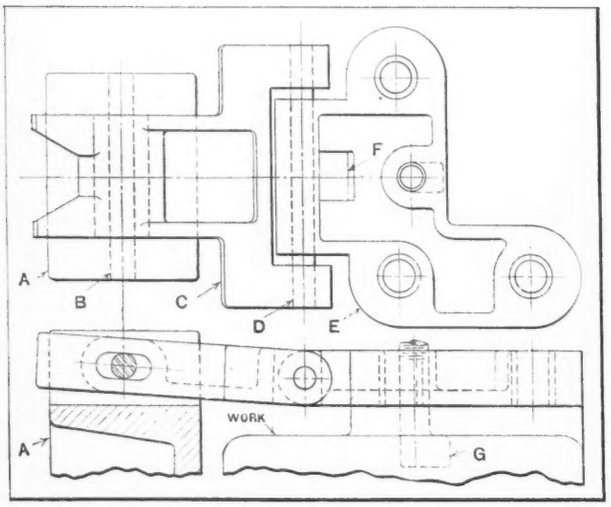
Dayton, Ohio — W. P. GALLOWAY

FLOATING LEAF FOR JIG

When a flange or face has to be drilled with holes located in a certain relation to the edge, a floating jig leaf is often required. This leaf must also be kept



Adjustable Work-support which can be Applied to Any Fixture



Jig Leaf of Floating Design

square with the work. The jig leaf illustrated was designed to meet these requirements, and is used for drilling and tapping the face at the top of the work partly shown.

The member *C* is made a sliding fit in the jig *A*, so that the leaf *E* will always be square with the work. The pin *B*, driven into the jig, is a slip fit in the elongated hole in member *C*. This arrangement permits the leaf to be moved either to the right or left. To provide a floating movement at right angles to that already described, the leaf is made a sliding fit on the pin *D*, the latter being driven into member *C*. For any variation in the height of the facing, the hinging action, as shown in the lower view, allows the leaf to drop on the facing squarely. The edge *F* is merely a sight hole for lining up the leaf with the contour of the work. After the jig is properly located, it is clamped to the work by means of the hook-bolt *G*.

Fairfield, Conn. J. E. FENNO

DRILLING HOLES IN KNIFE BLADES

The illustration shows the method used for drilling holes for the pivot pins of pocket knife blades at the factory of the Schrade Cutlery Co. A slight depression is forged in the blades to start the drill correctly. Previously, the work was done by laying the blades on a block on the drilling table, but owing to the time lost in removing chips, lubricating the drill, etc., the method shown was devised, and is being used with success. The drill breakage has been reduced considerably, and a longer life between grinds is secured by having more solid conditions.

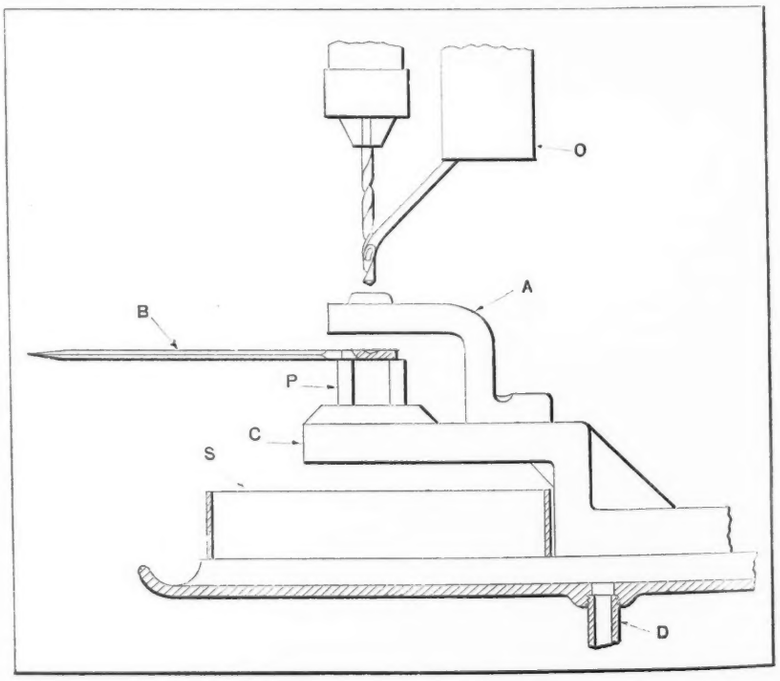
The knife blade *B* is laid on three pins *P* which furnish a support that does not collect chips as readily as the block previously used. These pins are set in the casting *C*, which, in turn, is clamped to the drilling machine table and carries support *A* for the drill bushing. The oiling is taken care of automatically by a reservoir *O*, arranged with a pipe which delivers a sufficient amount of oil to the drill. A cutting compound might have been used, but it has been found that oil maintains the hole size to a closer degree and prolongs the life of the drill. A brass wire screen *S* is arranged under the projecting part of *C* to catch the oil and chips. The oil works through the screen onto the table, whence the outside channels carry it to the return pipe *D*. Extensions of the screen protect these channels from becoming clogged with chips.

Middletown, N. Y. DONALD A. HAMPSON

AUXILIARY DRILLING MACHINE TABLE FOR PRECISION WORK

Drilling machine tables are often out of square with their spindles, and serious troubles are encountered in drilling a deep hole with an inaccurate machine. Spindle wear might seem to be the most likely source of error, but this generally causes the least trouble, as far as accuracy is concerned. Even when the spindle is a trifle loose, the ball thrust bearings have a tendency to keep it vertical when revolving under load. As castings are usually employed for both column and table, insufficient seasoning prior to finish-machining may result in warping. Excessive pressures on the spindle or careless handling in shipment and erection sometimes causes stresses resulting in a permanent set of the table. Also, inaccuracies from ordinary wear are inevitable.

A drilling machine may be converted into a precision tool with little trouble and cost by following the method shown in Fig. 1. A cast-iron "sur-



Method of Drilling Knife Blades

table," as it is termed, is made to fit over the machine table, being designed with ribs underneath to insure rigidity and strength without adding undue weight. The detail of this table is shown in Fig. 2. Unlike the machine table, it is not attached to the column. Usually it is safe to design the table along lines similar to the machine table, although for small bench machines, a thick steel plate may be employed, if the top surface is perfectly flat and true. When making the surtable, bosses should be provided for the set-screws on the under side at three as nearly equidistant points as practicable, and as near its edges as possible, the top surface being planed true.

The set-screw holes are counterbored on the top surface for check-nuts. The counterbores should be large enough to admit a socket wrench. Both screw-heads and check-nuts should be below the top surface to avoid interference with the work. The set-screws should be of sufficient length to allow the points to project about 3/8 inch below the bottom surface of the surtable. Previous to tapping the holes, the table is placed centrally over the machine table and located through the tap drill holes by spotting, the depth of the spot slightly exceeding that of the screw point. Careful checking is necessary to make certain that the set-screw points engage accurately in the spots, rounded or dog points being best for the purpose. In providing for machines equipped with round tables that swing from the column, precaution should be taken to align the center of the table with the axis of the spindle; and when close precision work is undertaken, with the table swung to one side, it is well to check the table surface in the manner described in the following paragraphs:

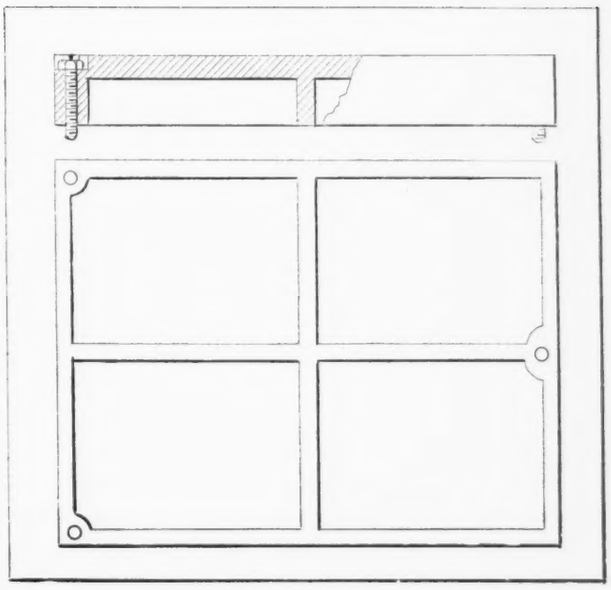


Fig. 2. Surtable having Three-point Adjustable Stops to Facilitate Squaring up on Drilling Machine

The surtable is now aligned square with the spindle as follows: Bend a piece of mild steel rod L-shaped, one leg being about equal to the distance from the axis of the spindle to the nearest edge of the surtable, and the other end being just long enough to secure firmly in the drill chuck. After seeing that the spindle saddle is firmly clamped to its slide, bring the spindle to its highest position. Next attach a dial test indicator to the free end of the test rod. Fasten the machine table securely in place, so that the indicator button bears properly on the surface of the surtable as shown. Revolve the spindle slowly by hand, noting its reading at the three points near the set-screws. Tighten the set-screw lock-nuts, so that the screws may just be turned, and adjust all three screws until the reading at each point is the same. Now tighten all the check-nuts and check with the indicator again to make sure that in so doing the screw adjustment has not been disturbed. If no dial test indicator is available, a heavy wire, bent to crank shape and with the end that points downward sharpened to a fine point, may be used instead. In this case, the surface of the surtable should be chalked to mark the spots where the pointer bears. The dial test indicator, however, permits greater accuracy, the other method being merely a makeshift. In large machines, the surtable should be secured with bolts or screws from the under side of the machine table to prevent disturbance when drilling heavy work.

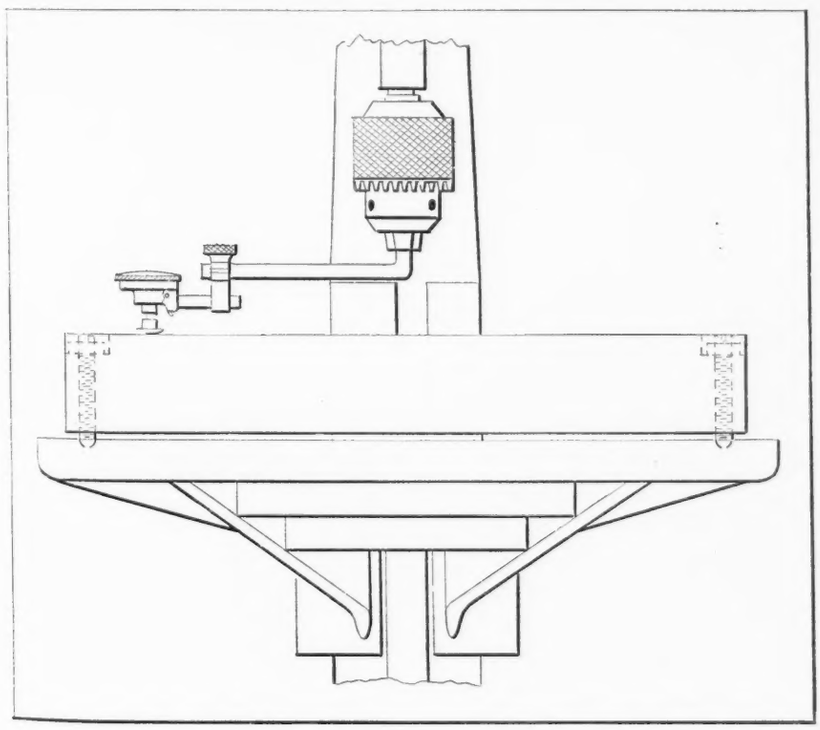


Fig. 1. Method of Squaring up the Surtable Shown in Fig. 2

It is safest to check up the align-

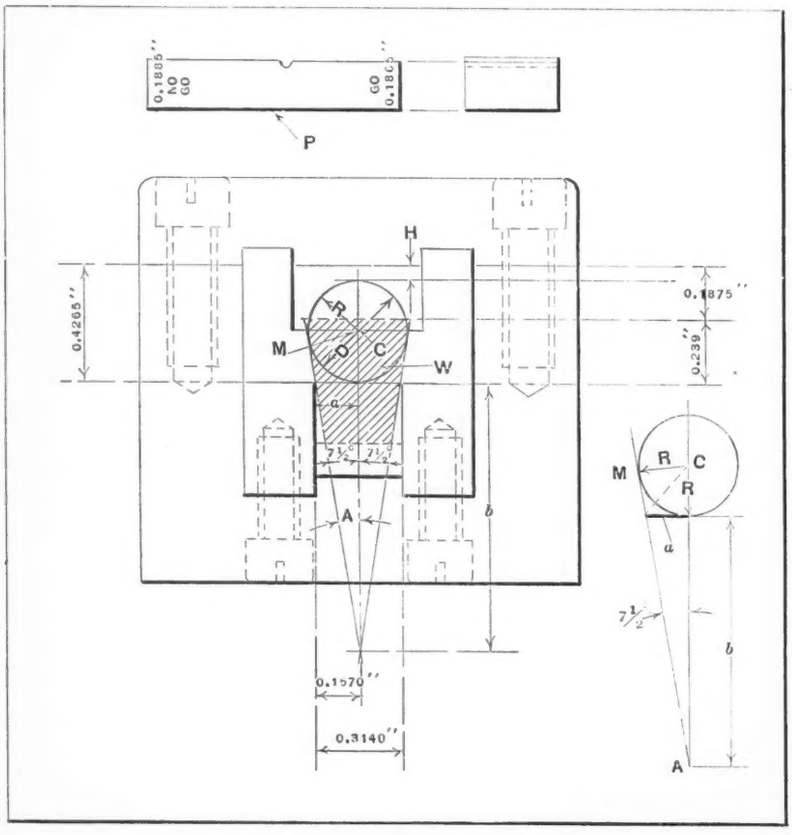
ment each time before starting a precision job, as both the inspection and adjustment, if the latter be necessary, should require only a few minutes. It has been found, however, that the surtable will lose its adjustment in a surprisingly small degree, once the screw points have seated themselves.

Elizabeth, N. J. PAUL LEO

CHECKING A TAPER GAGE

In the accompanying illustration is shown a gage for checking the taper of the part shown in cross-section at *W*. After the work is placed in the gage as shown, the "Go" and "No Go" plug gage *P* is used for checking the 0.1875-inch dimension.

In making the gage, it was necessary, for check-



Taper Gage and Diagram Used in Solving Problem Involved in Checking Accuracy of the Gage

ing purposes, to find the diameter *D* of a rod that would be tangent to the tapered gaging surfaces at some point *M* and also be tangent to the line 0.239 inch below the top of the part *W*. The dimension *H* was also required. The diagram in the lower right-hand corner shows the principal dimensions involved in the calculations. In this problem, we have the angle *A* equal to 7 1/2 degrees and the side *a* equal to 0.1570 inch. The problem is to find the radius *R*. Of course, *R* equals *a* divided by the tangent of the angle *C* opposite side *a*. However, considerable calculating is involved in solving for this angle. In looking over the problem, the writer derived a formula for *R* which simplified the solution. The formula is:

$$R = \frac{b \sin A}{1 - \sin A}$$

The derivation or proof of the formula is as follows:

$$\text{Side } b = \frac{a}{\tan A} \text{ or } a \cot A$$

Now in the right triangle *AMC*, we have,

$$AC = b + R$$

According to trigonometry, $(b + R) \sin A = R$ and

$$b \sin A + R \sin A = R$$

Dividing both sides of this equation by *R*, we have,

$$\frac{b \sin A}{R} + \sin A = 1$$

Transposing,

$$\frac{b \sin A}{R} = 1 - \sin A$$

or

$$R\ (1 - \sin A) = b \sin A$$

Then,

$$R = \frac{b \sin A}{1 - \sin A}$$

Also,

$$b = \frac{R\ (1 - \sin A)}{\sin A}$$

Applying our formula to the solution of the problem under consideration, we have

$$R = \frac{b \sin 7\ 1/2 \text{ degrees}}{1.0000 - \sin 7\ 1/2 \text{ degrees}}$$

Substituting the numerical value for *b*, which equals 0.1570 × cot 7 1/2 degrees, and solving the equation, we have

$R = 0.1790$ and $D = 2 \times 0.1790$ or 0.3580 inch

The dimension *H* therefore equals

$$0.4265 - 0.3580 = 0.0685 \text{ inch}$$

Villa Park, Ill. C. W. HINMAN

LOCATING THE DECIMAL POINT IN SLIDE-RULE CALCULATIONS

The application of the following rules for locating the decimal point in results obtained with a slide-rule, will help to obtain accuracy. It should be noted here that the right-hand index of the scale, as well as of the slide members, although marked with the figure 1, actually have the value 10. Owing to this fact, it is necessary to modify the general rule according to the paragraphs in-

dicated as (A) and (B) in the following rules for multiplication and division when these index lines are involved.

Locating the Decimal Point in Multiplication—To find the number of figures in the product obtained by slide-rule calculation:

1. Add the number of figures contained in all the factors.

2. Subtract 1 for every result obtained with the slide failing to project to the left. (See following exceptions).

Exceptions to Rule 2:—A. Never subtract 1 when reading is on right-hand index-line of the scale (as in 40 × 250 multiplied with the left-hand index of slide).

B. Always subtract 1 when reading is directly opposite the right-hand index-line of the slide (as in 37.5 × 100 multiplied by using the right-hand index-line of the slide).

Locating the Decimal Point in Division—To find the number of figures in the quotient when dividing by the use of the slide-rule:

1. Subtract the number of figures contained in all the factors of the divisor from the number of figures contained in all the factors of the dividend:

2. Add 1 for every result obtained with the slide failing to project to the left. (See following exceptions).

Exception to Rule 2—A. Never add 1 when the setting is on the right-hand index-line of the scale (as in 1000 ÷ 40 performed with the right-hand index of the scale).

B. Always add 1 when the setting is directly opposite the right-hand index-line of the slide (as in 3750 ÷ 100 performed with the right-hand index-line of the slide).

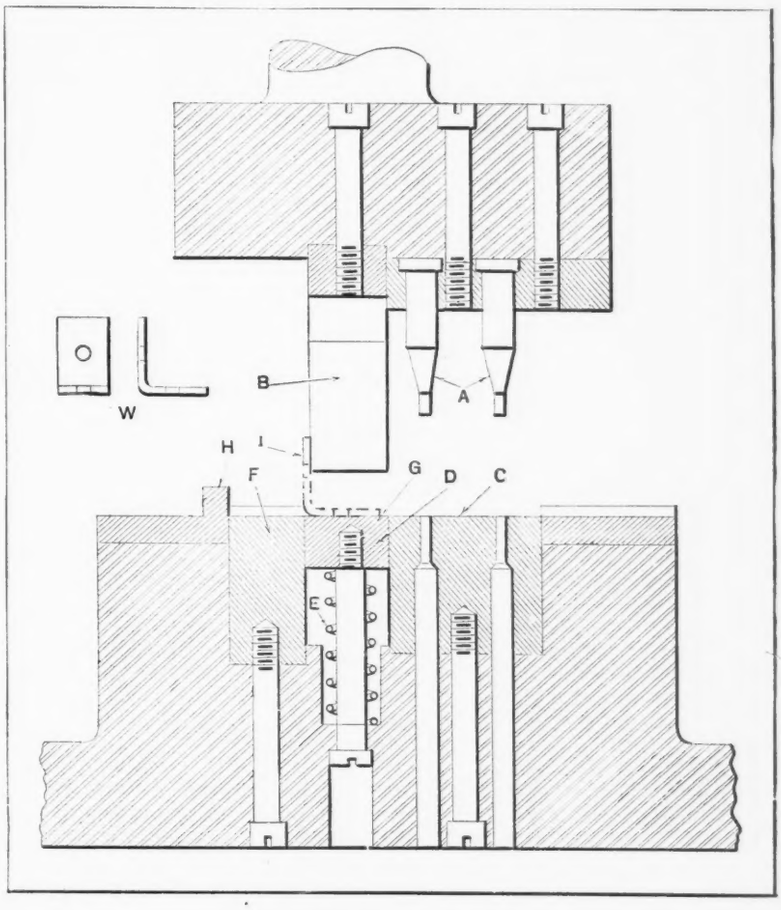
The following examples are given to make clear just how the above rules are applied: First multiply 22 × 45.455. The number of figures in the whole number of factors is 2 + 2 = 4. In this case, the slide fails to project to the left, but the reading of the result is taken on the right-hand index-line and therefore we do not subtract 1. This is in accordance with exception (A) of the rules given for multiplication. We therefore have the answer 1000.

Next let 28.5 be divided by 10. This operation is performed with the right-hand index-line of the slide, taking note of exception (B) given in the rules for division. In this case we have two places in the divisor to be subtracted from two places in the dividend, which equals zero. According to rule (B) for division, we always add 1 when the setting is directly opposite the right-hand index of the slide. Therefore, we have one place in the answer which equals 2.85.

Philadelphia, Pa. B. W. BARISH

DIE FOR MAKING SMALL ANGLE-BRACKETS

The die here illustrated is used for the rapid production of small angle-brackets like the one shown at *W*. These brackets are made from 16-gage material having a width of 1/2 inch. A hole about 1/8 inch in diameter is punched in the center of each leg of the bracket. The punch member consists essentially of the two piercing punches *A* and the combination cutting-off and bending punch *B*. The die member consists of the piercing die *C*, the spring pad *D*, supported by two springs *E*, and the forming block *F*. It will be noted that the punch and die members are held in place by screws extending through their respective holders.



Die for Producing Angle-brackets

The brackets are made from either strip or coil stock. The stock is fed into the die from the right-hand side until the end projects slightly over the cutting edge at *G*. Then the press is tripped so that the end of the stock is squared up, after which the stock is fed through to the stop *H*. On the next downward stroke of the press, the first piece is cut off and formed to the right-angle shape indicated at *I*, and the second piece is pierced. After this, the stock is fed through to the stop *H*, and a bracket is completed at each stroke of the press. The edge of the forming block *F* is slightly rounded. The press is inclined, so that the brackets fall into a receptacle at the rear of the die.

Cincinnati, Ohio E. A. SISSON

SCREWDRIVER ATTACHMENTS

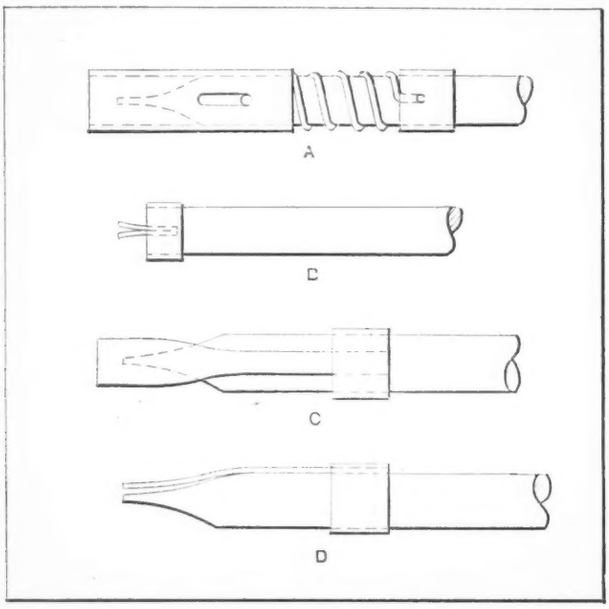
Several ways of fixing screwdrivers ends so they will hold screws while starting them in inaccessible places are shown in the accompanying illustration. The arrangement shown at *A* consists of a sliding shell on the end of a screwdriver, with a spring to hold it in position beyond the end of the blade. This shell, which supports the head of the screw, moves back out of the way if the screw-head seats in a countersunk or counterbored recess. A stop-pin is added to retain the shell. This design necessitates the use of a special screwdriver for each size screw-head.

At *B* is shown a screwdriver made of two spring blades inserted in a slot in the end of a rod, and held by a ferrule. This tool is used for starting screws only, although it may be used on light work if made strong enough, or when screws only need to be assembled without much tightening.

The screwdriver shown at *C* has two spring clips on opposite sides of the blade, held by a ferrule, the ends extending beyond the blade and curved to approximately fit the heads of the screws. This type will accommodate a variety of sizes if the slots do not vary too much.

Another type of screwdriver shown at *D* has a single thin spring blade, flush with the end of the screwdriver blade, and held by a ferrule, the blade and spring entering the screw slot together. To use this construction, the screw slots need to be fairly wide, but it makes a stronger tool than that shown at *B*.

The ferrules used in all cases are slipped over the shank before forging the ends of the screwdriver,



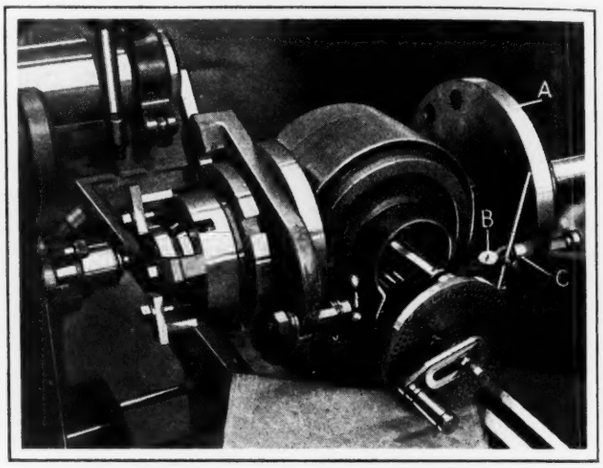
Different Arrangements for Holding Screws on Screwdriver when Starting Them in Inaccessible Places

unless one end is left small enough to allow assembling later. Magnetized screwdrivers are also used successfully on screws of such materials as are attracted by magnets.

Farmington, Conn. ERNEST L. HOLCOMB

PRECISION INDEXING

In the accompanying illustration is shown a method for checking the accuracy of indexing movements, which is applicable to jig work and which eliminates errors that may possibly result from inaccuracies in the indexing head itself. A special "certified" plate *A* having precision-located holes is attached to the indexing spindle at the rear of the mechanism housing. This plate is accurately located with reference to the rotation of the index-



Using Certified Plate for Checking Indexing Movements

ing spindle, that is, no run-out either peripherally or sidewise is allowed.

An indicator *B* is permanently fixed to the platen of the machine in such a position that contact with the standard plug *C* can be conveniently made when the plug is inserted after an indexing movement has been made. The plug and indicator provide a means of verifying the regular indexing movements of the head or other indexing tool which may be used. Most indexing heads are provided with an adjusting mechanism which will compensate for small errors in the head itself. These mechanisms generally operate through the crank, and such errors as may be indicated by the plug and indicator mentioned can be easily corrected by means of the compensating mechanism.

Springfield, Vt. O. S. MARSHALL

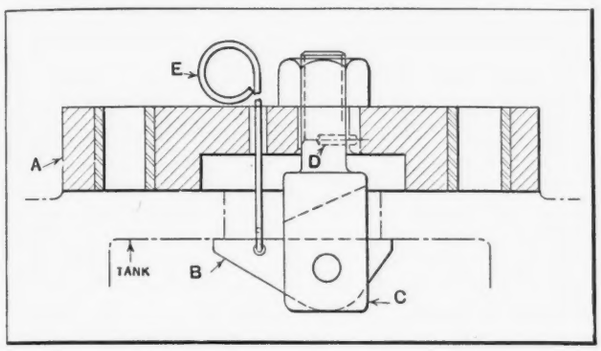
LOW AIR PRESSURE WARNING FOR PRESS CUSHIONING SYSTEM

A device such as described here for warning the press operator when the air pressure of a pneumatic cushioning system has reached the minimum limit, may prevent serious damage to the dies. The device consists of an electric circuit closer attached to the moving part of the pressure regulator in such a manner that a red lamp will be lighted directly in front of the operator when the pressure drops to the minimum limit. If it is desired to provide a switch for breaking the circuit, it should be of the knife type and so placed that the handle will interfere with the tripping of the press when the switch is open. S. B.

Shop and Drafting-room Kinks

FLANGE JIG WITH TIPPING CLAMP

The jig here illustrated is used for drilling the stud holes in an outlet flange on a cast-iron tank. This type of jig has proved superior to that provided with the regular hook-bolts, as it is quicker



Jig with Special Clamp Designed to Pass through a Small Hole

acting and more positive in clamping. The plate *A* is of the same shape as the tank flange, and carries the drill bushings and the clamping device, the latter having a "tipping" clamp *B* swinging loosely on a pin in the forked member *C* which is prevented from turning in the plate by the pin *D*, one end of which is confined in a slot in the plate.

In applying the jig to the work, one end of clamp *B* is tipped downward by pushing down on the wire *E*. This tipping action allows the clamp to pass through the hole in the flange. After the jig has been brought down on the face of the flange, the wire *E* is pulled up. This raises clamp *B* to a level position, the entire jig then being shifted until its contour coincides with that of the flange, after which the nut is tightened.

Fairfield, Conn. J. E. FENNO

REMOVING DOWEL-PINS

In removing parts held in place on a die or machine by screws and dowels, the dowel-pins should be driven out before the screws are loosened. If it is necessary to remove the pins last, they should be driven out toward the larger body to prevent the parts from separating unevenly and bending the dowels. S. B.

DRILLING HOLES IN LEAD

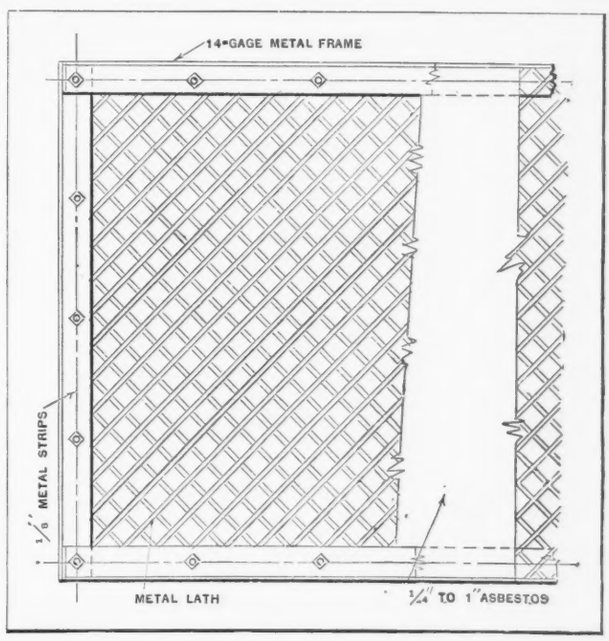
In a scrap-book that I have kept, I have the following information on how to drill lead, and as I know that most machinists find it a very difficult task to drill this metal, I am passing it on to others. The difficulties in drilling lead are due to heated drills which tend to stick, to burrs which form at the edges of the holes, and to crawling chips which tend to enlarge the holes. The best lubricant seems to be lard oil. By using plenty of oil and lifting the drill out of the hole at frequent intervals during the drilling, the usual difficulties are avoided.

OBSERVER

BUILT-UP FURNACE SHIELD

The usual method of closing the open ends of heat-treating furnaces is by means of shields, but these are often clumsy and ill fitting. The shield construction shown in the illustration combines both neatness and rigidity. It consists of a 14-gage black iron frame, formed to an angle cross-section, with the corners welded. The screening consists of an asbestos sheet which is placed between two pieces of metal lath, the whole being fastened to the frame by means of 1/8-inch metal strips and 1/4-inch bolts.

The completed shield is comparatively light, and the expanded metal protects the asbestos filler effectively. The edges of the asbestos filler are protected by the sheet-metal frame, which forms a flange around the edge of the shield. The shield may be mounted on legs, or attached directly to the



Construction of Shield Used for Closing Opening in Furnace

furnace sides by means of brackets; a very large shield may be made to stand on the floor, to be moved from place to place as desired.

H. C. CHARLES

Questions and Answers

OBTAINING BLACK FINISH ON STEEL

C.R.M.—Will someone please describe the method ployed in obtaining the black finish on the metal parts of army rifles?

A.—According to J. B. Nealey, American Gas Association, the work is charged into a retort with charred bone, heated to 900 degrees F., and cooled slowly to 650 degrees F. The bone is then removed, saturated in mineral cylinder oil, and returned to the retort, the whole charge being held at 650 degrees for three hours. Next the work is removed and quenched in oil, which gives it a black finish. The finish thus obtained has twice the life of a blue finish.

HARDENING DRILL ROD

E. R.—How can drill rod 1/8 inch in diameter, in lengths of about 10 inches, be hardened so as to remain straight after hardening? I would also like to know of any firm who is prepared to do hardening work of this kind or who sells hardened drill rod.

Answered by Jacob H. Smit, Newark, N. J.

To harden long thin pieces of steel and keep them straight is a rather difficult task. The following suggestions, however, may prove helpful. One method is to place the work in a piece of pipe which is revolved while the work is being heated to the hardening temperature. Work hardened by indirect heat in this way seems to retain its straightness better than when it is heated in an open fire or furnace. The results obtained also depend to a considerable extent on the method of quenching. In some cases, good results are obtained by heating the work in an upright position and allowing it to drop vertically into the quenching bath.

Another method is to roll the drill rod between two metal plates instead of quenching in the usual manner. The lower plate should be set in a tank filled with water, the water level being just a little below the top of the plate. The top plate should be suspended from a roller which can be raised or lowered by means of a cam. The rise of the cam should be sufficient to enable the upper plate to be lifted enough to clear the drill rod. After the drill rod is heated, it is placed on the lower plate, which is chilled by the water. The suspended plate is quickly lowered and is rolled back and forth while resting on the rod. As soon as the drill rod has been rolled back and forth a few times, streams of water should be directed on the work from both sides. The object in rolling the work back and forth before applying the water is to straighten it between the plates.

Valves placed on each side of the plates, and operated by means of a foot-treadle or other convenient means, should be provided for the water pipes, so that the work can be flooded or quenched at the proper moment. The outlets from the water pipes should be wide, in order to throw a broad stream of water on both sides of the work simultaneously, as the metal plates are not sufficient to give the required chilling.

An overflow pipe in the tank will take care of the excess water. The weight of the upper plate should not be so great that there is danger of reducing the diameter of the drill rod. A stream of compressed air is effective in blowing the scale and water from the bottom plate. If water is left on the plate, one-sided cooling will take place which is, of course, detrimental.

A method of hardening wire, which may also be of interest, is to hold the wire under spring tension between two chucks while heating it by means of an electric current. The fixture should be mounted on a swivel, and as soon as the work is heated to the required temperature by the passage of the electric current, the fixture is turned over and dipped into a tank of water. The current is automatically broken before the fixture reaches the water.

Pieces of drill rod which show only slight bends may be straightened by rolling on a heated plate and peening on the hollow side. Another way is to heat the work on the hollow side with a sharp-pointed flame until it is nearly blue in color at one spot, and then dip it in the quenching bath. Straightening may also be accomplished by holding the ends of the piece in chucks or vises while heating the hollow side and pressing the work over with a bar.

The following method was employed in hardening a long piece of drill rod: A piece of two-inch gas-pipe somewhat longer than the work was closed on one end and filled with water. The drill rod was suspended above the gas-pipe by means of a counterweight attached to a light rod, running over a small pulley. The lower part of the rod was heated with a blow-torch, and when the required heat was obtained, the rod was allowed to descend slowly into the water in the gas-pipe, while the rod itself was turned continuously in order to obtain uniform heating on all sides. The rod was kept red-hot for a length of about 2 inches above the water.

* * *

The exposed steel parts of Boeing airplanes are plated with cadmium to insure them against injury by corrosion, according to an article in *Automotive Industries*. It is stated that cadmium was selected by the engineering department after much experimentation. In one of the tests, a part plated with cadmium was subjected to a salt spray bath for 100 hours without corroding.

The British Metal-working Industries

Little Change in Industrial Conditions Evidenced During Month —Interest Centers on International Aero Exhibition

From MACHINERY's Special Correspondent

London, August 12, 1929

CONDITIONS in industry as a whole are less satisfactory than has been the case for some time. Disputes in the cotton and the coal mining industries, together with the seasonal decline in many trades, are serving for the moment to cast a gloom over the situation. There is, however, no reason as yet, for undue anxiety, and there will probably be a general renewal of activity after the holidays.

The Machine Tool Industry is Well Employed

The machine tool industry remains well employed. In some cases, orders have not been booked so freely of late, but the majority of manufacturers have sufficient work in hand to tide them over the holiday period, and there is every indication that the present year will prove to have been the most satisfactory experienced for a considerable period.

With the increasing use of metal in airplane construction, a new field is steadily developing for special types of machine tools, and manufacturers catering to the needs of this industry will undoubtedly soon experience a rapid increase in demand.

Overseas Trade in Machine Tools Shows Slight Decline in June

The tonnage of machine tools exported during June was considerably below the average for the present year. The total for the month was 1004 tons, as compared with 1631 tons in May and 1507 tons in April, the former figure being the lowest recorded since September of last year. The value of exports did not fall in proportion to the tonnage, the total for the month being £150,236 as compared with £189,020 in May, and £195,489 in June. In consequence, the ton value of exports showed an increase from £116 in May to £150 in June.

Imports of machine tools in June fell slightly in tonnage, as compared with May, the totals for the two months being 877 and 1009 tons, respectively. The value of imports, on the other hand, rose slightly from £172,936 in May to £178,841 in June, with the result that the ton value reached the unusually high figure of £204. Exports of tools and cutters during June were valued at £44,377, as compared with £65,267 tons in May and £47,360 tons in April.

Considering the first six months of the present year, machine tool exports have shown the usual month to month variation, but the average in both tonnage and value is above the figure for the corresponding period in 1928. The distribution of machine tool exports indicated that the substantial gains in European markets noted during recent months are being maintained. There has been a small gain in South Africa, a proportionately heavier fall in Australia, and in places other than these a substantial gain.

Activity is Evidenced in the Shipbuilding Field

According to Lloyd's Register of Shipbuilding, the total tonnage of vessels under construction in Great Britain and Ireland at the end of June was 1,453,906. This figure exceeds by 96,531 tons the total for vessels under construction at the end of March this year, and is greater by 251,296 tons than the corresponding figure for the end of June, 1928. Of the tonnage under construction at present, 66,000 tons is destined for the British dominions, while 208,000 tons are for foreign ship-owners.

By comparison, it may be noted that the tonnage under construction in all other countries at the end of June amounted to 1,384,319, which represented a decrease of 96,118 tons on the March total. Great Britain and Ireland thus account for 51.2 per cent of the tonnage building in the world. Of the tonnage building in Great Britain and Ireland, motor ships account for 590,429 tons, or rather more than 37 per cent. On the other hand, the tonnage of motor ships being built in other countries amounts to 841,791 or nearly 61 per cent of the total.

The Airplane Industry Holds Exhibit

During recent weeks interest in the aircraft engineering industries has been centered on the International Aero Exhibition which was held at Olympia from July 16 to 27. Perhaps the most striking feature of the exhibition was the extent to which metal has replaced wood and fabric in airplane construction during the nine years since the last exhibition was held at Olympia. On that occasion only one all-metal machine was exhibited, while at the recent exhibition machines of all-metal construction were to be found on the majority of stands, and steel and duralumin were largely employed.

Iron and Steel Production Increases

According to figures issued by the National Federation of Iron and Steel Manufacturers, the number of furnaces in blast at the end of June was 165, a net increase of 6 since the beginning of the month. The production of pig iron in June amounted to 657,800 tons, compared with 654,800 tons in May, and 563,700 tons in June, 1928. The June output of ingots and castings amounted to 830,800 tons, compared with 843,800 tons in May and 709,000 tons in June, 1928.

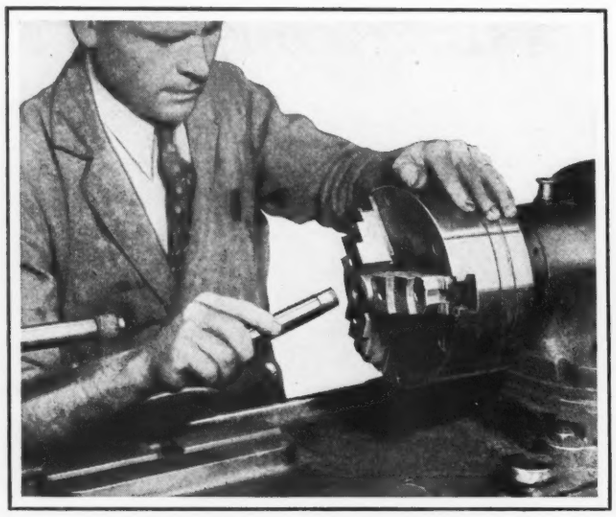


Fig. 1. Using One End of the Mandrel Shown in Fig. 3, as a Feeler Gage on Work Partially Finished

Fig. 2. Using the Opposite End of the Mandrel as a Plug Gage for Inspecting Finished Parts

A LATHE MANDREL OF MANY USES

A mandrel that can be applied as a gage and as a means of checking micrometers, in addition to being used in the ordinary way, is shown in Fig. 3. It may be employed as a feeler gage, for instance, in taking a final grinding or boring cut on holes in gears, bushings, cutters, etc., to determine how much stock remains to be removed. Such a use is shown in Fig. 1. For gaging operations of this sort, the operator employs the rather steep tapered section near the right-hand end, as shown in Fig. 3, in combination with the taper of the regular mandrel section. This use is particularly convenient on small holes, and on medium-sized holes, it eliminates the necessity of applying calipers. The mandrel has four definite uses, and has been designated the "4 in 1" mandrel by the manufacturer—the Ampco Twist Drill Co., Jackson, Mich.

Fig. 3. Mandrel that May Also be Used as a Gage and as a Micrometer Check

Fig. 2 illustrates how the plug gage section at the left-hand end of the mandrel can be used for inspecting parts. Fig. 4 shows a lathe operation in which the mandrel is being used, between headstock and tailstock centers, in the ordinary way, for holding a part to be turned and faced. The fourth distinct use, that of checking micrometers, is illustrated in Fig. 5. The mandrel is made in various stock sizes from 1/4 to 2 inches with proportionate overall lengths. In shops equipped with different sizes of the mandrel, micrometers can be carefully checked at those sizes.

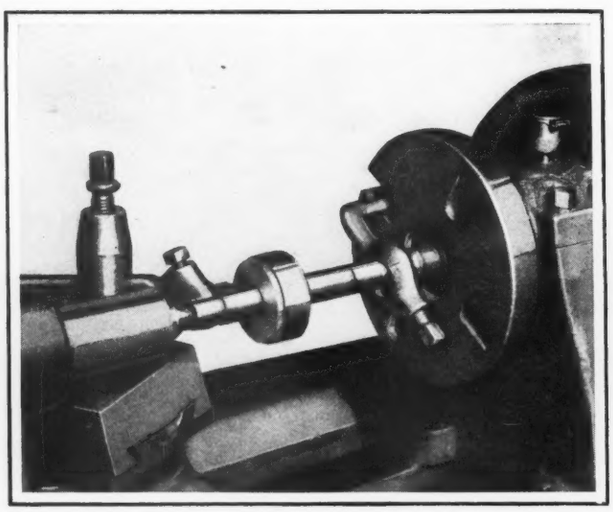


Fig. 4. Using Mandrel in Ordinary Way for Supporting Work being Turned and Faced

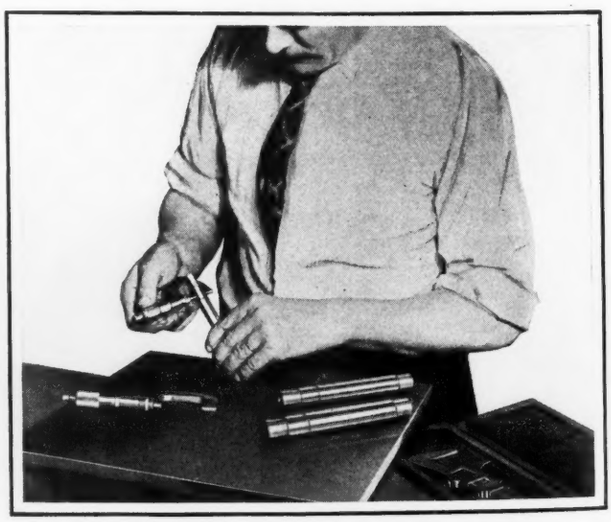


Fig. 5. Checking Micrometers on the Plug Gage Surface of the Mandrel

Sheet-Metal Rolling and Forming Methods

Operations Performed in the Production of Tubular Sheet-metal Parts of Various Shapes—Second of Three Articles

By FRANK H. MAYOH

Methods of forming tubular parts from sheet metal through the use of a press and rolling equipment were described on page 913 of August MACHINERY. In the present article a method of employing grooved rolls for sizing tapered metal tubes is described. The operations of forming tubes from flat stock by rolling and the crimping of the ends of metal tubes already formed are also described in this article.

Rolling Tapered Metal Tubes

The machine shown in Fig. 5, for rolling tapered tubes like the one shown at *T*, is constructed very ruggedly, as the operation is of a swaging nature. These tubes are rolled to size by passing them twice through rolls *A* and *B* of the machine, shown partly in section. Rolls *A* and *B* are keyed to the drive shafts *E* and *F* which, in turn, are driven by gears *G* and *H*, the latter also being keyed to their shafts. Gear *H* is driven by a pinion *J* through the medium of a pulley *K*.

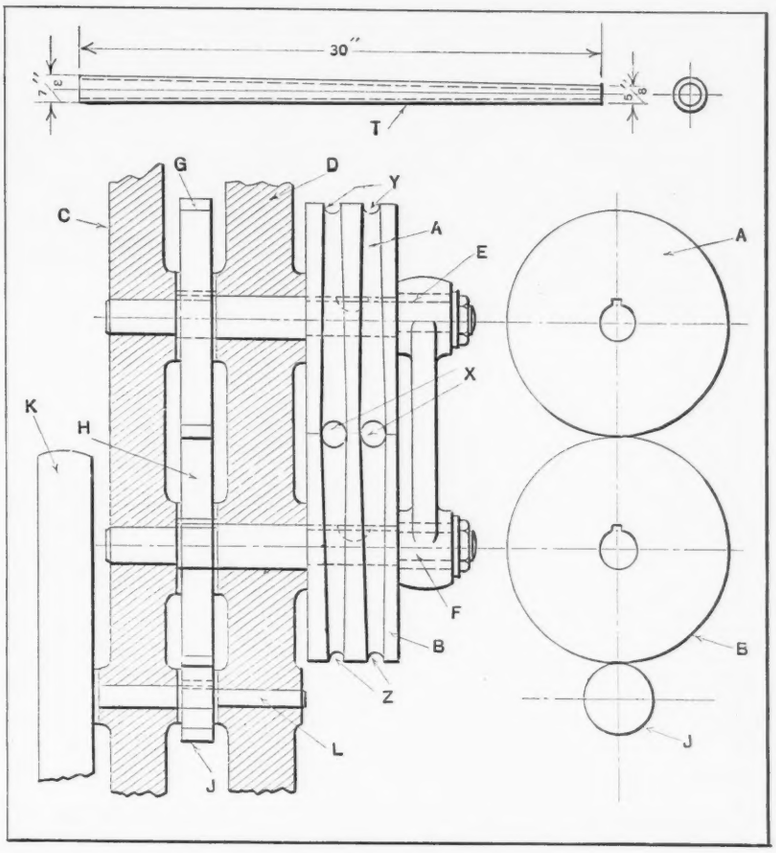


Fig. 5. Rolls and Driving Gears of Machine for Rolling Tapered Tubes to Size

The diameters of gears *G* and *H* are the same as the rolls. The rolls are grooved tapering; that is, the rolls at the position *X* form circular openings equal in diameter to the diameters of the tapered metal tubes at their large ends, and the circular openings made by the grooves at *Y* and *Z*, when these points are together, are equal to the diameters of the tubes near the center, while on the opposite side of the rolls the grooves gradually taper down until they make openings equal in diameter to the diameters of the tubes at their small ends. The groove nearest the machine frame *D* is made to roll a diameter slightly larger than the finished diameter of the tube produced by the outer groove, so that roughing and finishing operations are accomplished with the same pair of rolls.

It is the purpose of this illustration to show simply the principle involved in the rolling of the tapered tubes, and while at *K* is shown a plain driving pulley, in the actual construction of this ma-

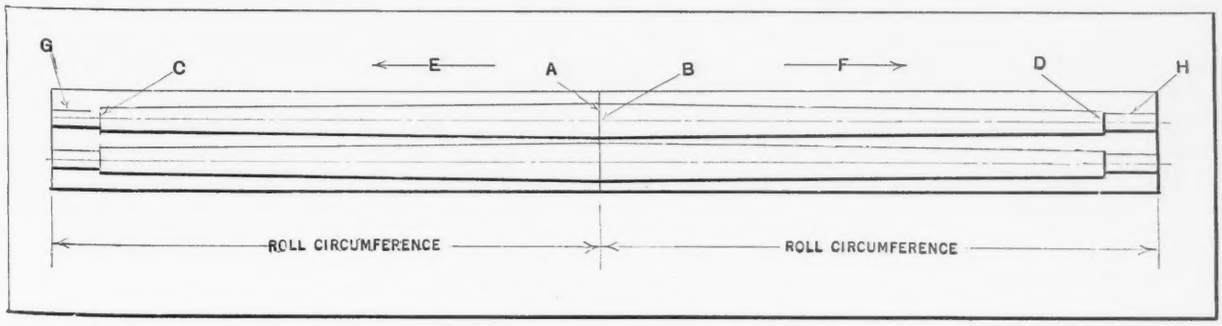


Fig. 6. Development of Tapered Groove in Rolls A and B, Fig. 5

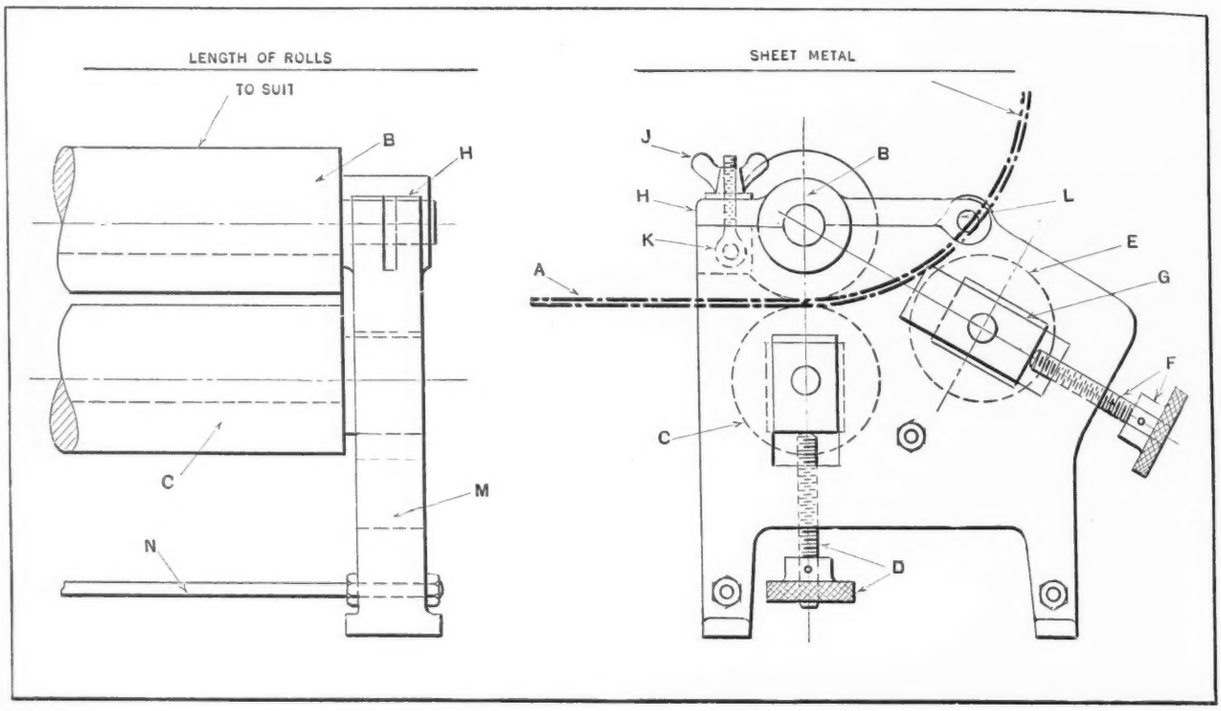


Fig. 7. Adjustable Curling Rolls for Tubular Stock

chine the shaft *L* that drives gear *J* is driven by a clutch arrangement and an additional gear reducing unit. The actual drive is such that the rolls are given one revolution and then stopped, so that the tubes may be put in place by the operator. One rough tube and one tube that has been passed through once are rolled at one pass of the rolls.

In these rolling operations the tubes are put on arbors. One arbor and tube to be rough-rolled and one arbor and tube to be finish-rolled are put in position, with the small ends of the tubes resting on the roll at the starting position, where the small radius of the groove comes. A slide at the back end of the tubes pushes them forward into the rolls when the machine is started, and the arbors counteract any curling tendency. A screw press is used to force the arbors out of the tubes.

Fig. 6 shows the development of the face of the rolls. The diameter for the larger ends of the tubes is indicated at *A* and *B*, while the smaller diameters are shown at *C* and *D*. As these surfaces roll together in the direction of the arrows *E* and *F*, when the machine is in operation, the tubes naturally assume the size of the grooves. The smaller straight sections *G* and *H* represent portions of the rolls not required in rolling but that were machined when the rolls were first set up in a lathe for rough-turning the grooves preparatory to cutting the tapered grooves in a special set-up in a lathe. The complete operation of machining the tapered grooves will be described in a later article.

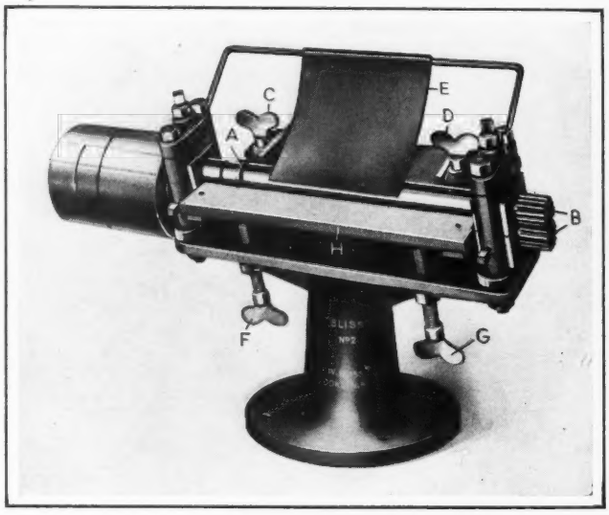


Fig. 8. Machine Used in Forming Can Bodies and Similar Work

Producing Tubes from Flat Stock

Among rolling operations that are not generally understood in the machine shop, although commonly employed in the forming of sheet metal, is the one illustrated in Fig. 7. The machine shown is built for the purpose of rolling flat sheet metal into circular parts, either as complete tubes or as segments.

The flat piece of sheet metal *A* is fed under a fixed roll *B* and over a roll *C* which can be adjusted vertically, by means of knob *D*, to accommodate various thicknesses of stock. A third roll *E* is mounted in bearings which can be adjusted in the elongated slot *G* by the knob *F*.

The radial adjustment of roll *E* up or down relative to roll *B* determines the curvature of the sheet of metal *A* as it is passed through the machine, the metal being rolled to a small or large radius, as required. Roll *B* is held in its bearing, which is made in two parts, by means of a cap *H*. Cap *H* is held down

by wing-nuts *J*, on hinged screws *K* and can be pivoted or swung back on hinge pin *L* when screws *K* are swung forward. This construction permits the upper half of the roll bearing to be swung back for the removal of roll *B*.

When complete tubular parts of sheet metal are made, the roll *B* must be removed or withdrawn from the end of the part. The frames at each end, one of which is shown at *M*, are tied together by rods *N*. A pulley and drive gears at the left-hand end of the machine (not shown), or a handwheel to replace the pulley, if the machine is used for general utility purposes, complete the machine. The principle involved in this work can be easily applied in the tool-room for doing an occasional bending job by simply setting up three arbors in their proper relative positions.

from the machine. In this set-up, adjusting screws *F* and *G* raise or lower the bar *H* which controls the diameter of the rolled piece.

Two rolling operations are illustrated in Fig. 9. The two rolls at the left form a double radius beading on the work *A*, such as is frequently seen on the tops of cylindrical tanks or tubs. This is obtained by passing the sheet metal between formed rolls *B* mounted in machines of the type shown in Figs. 7 and 8.

Crimping Operations on Tubes

The view at the right, Fig. 9, shows a simple mechanism for crimping the ends of tubular parts like the one at *D*. This mechanism consists of a crimping roll *C* keyed to a driving shaft *S*, with a gear *E* and a driving pulley *F* mounted on it. The

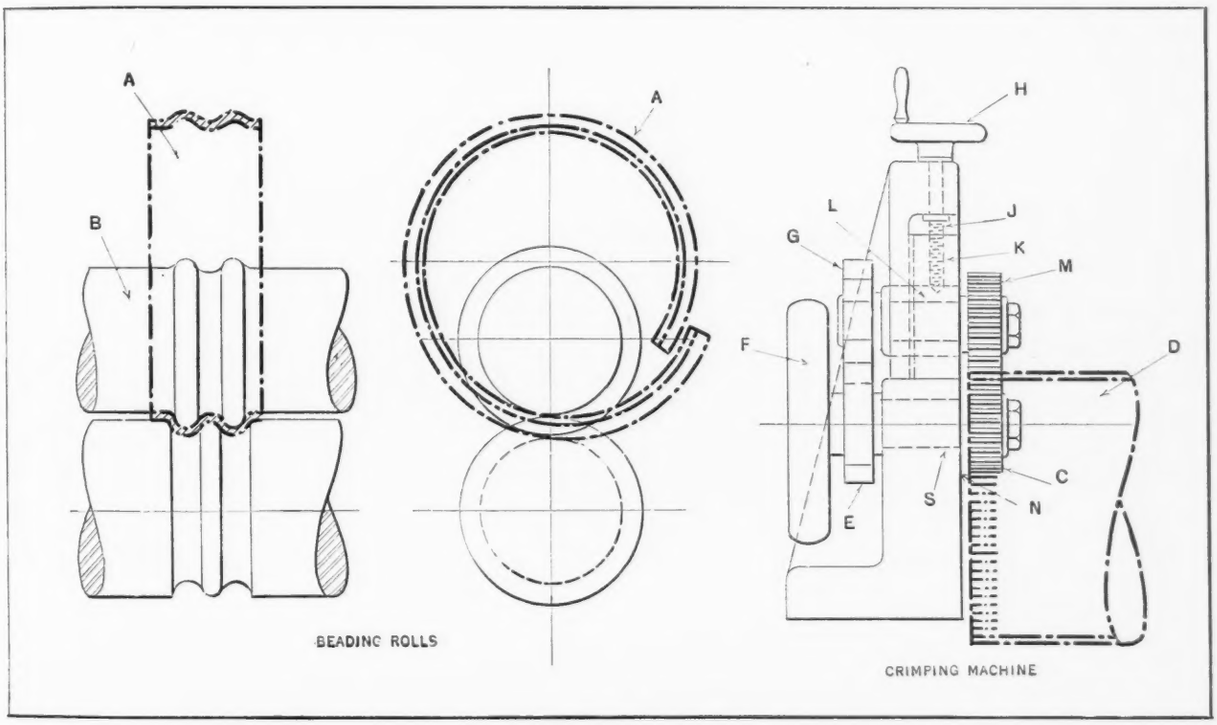


Fig. 9. (A) Double Beaded Work; (D) Work on which End is Being Crimped

In Fig. 8 is shown a machine that is a variation of the one just described. It is known as a power former and beader, and is used for forming can bodies or similar work, with or without a bead and in any size up to 9 inches long and 8 1/2 inches in diameter. This machine is shown equipped with beading rolls, the bead on the upper roll being indicated at *A*. This bead operates in conjunction with a groove in the roll below, the two rolls being geared together at *B*. The flat pieces of sheet metal fed successively between the continuously revolving rolls come out rolled to the correct diameter, with a beading around their edges corresponding with whatever combination or shape of beading is provided on the rolls.

The sheet metal is put through the rolls from the rear side. The gages, held in place by wing-nuts *C* and *D*, can be adjusted endwise relative to the beading. Plate *E* serves to strip the rolled sheet gear *E* has coarse cut teeth which mesh with the teeth in gear *G*. The coarse teeth permit a limited amount of center adjustment which is obtained by a handwheel *H*. The handwheel revolves the screw *J* which moves the bearing block *K* up or down. Block *K* carries the shaft *L*, on which the crimping wheel *M* is keyed.

There is a ring *N* on the arbor *S* in back of the crimping roll *C*, which acts as a gage. The roll *M* is so adjusted that there is a gap between the two crimping rolls when work *D* is put into position. Handwheel *H* is revolved so that the crimping roll *M* is embedded in the sheet-metal part *D*. The end of the work *D* is then crimped as it is revolved between the two rolls by the driving pulley *F*. For crimping heavy material, the drive from pulley *F* is through reducing gears.

A third article will follow in a coming number of MACHINERY.

$400 in Prizes for Articles on Ingenious Mechanisms

MACHINERY offers seventeen prizes for the seventeen best articles on ingenious mechanisms, each article to be confined to one mechanism or mechanical movement.

One prize—$100	in addition
Two prizes—each, $50	to regular
Four prizes—each, $25	space rates
Ten prizes—each, $10	

MACHINERY'S regular space rates will be paid not only for the prize-winning articles, but also for any articles accepted for publication that may not receive a prize.

Each contestant may send as many articles as he wishes. All will be entered in the competition and all may be accepted for publication; but no contestant will be awarded more than one prize.

Articles entered in this competition should be addressed to the Editor of MACHINERY, 148 Lafayette St., New York City. They must be mailed on or before November 15.

Preparing Articles for the Competition

This competition applies to any kind of mechanism making use of a practical and ingenious mechanical motion or principle. The competition is open to all, whether subscribers to MACHINERY or not. The general procedure is very simple.

1. Send a drawing of the mechanism (or photograph, if preferred—or both) that clearly shows all important parts of the particular movement to be described.

2. Describe as clearly as possible both the *purpose* of the mechanism and its *action—how* it does *what* it does.

3. Mark the important parts on the drawing, such as levers, cams, etc., with letters, *A*, *B*, etc., and use corresponding letters to identify those parts in the description; thus: "Lever *A* is operated by cam *B*." This will help to make the description readily understood.

4. Confine each article to a single mechanism or movement, and do not describe an entire machine or refer to parts that do not affect the movement being described.

Suggestions about Illustrations and Manuscripts

Clear blueprints or pencil drawings with distinct lines are satisfactory. They should be made on separate sheets of paper. Send only drawings that are "to scale," with the various parts shown in correct relationship and proportion. Rough free-hand sketches cannot be used. The drawing must show the assembled mechanism, although a diagram, or a drawing that is partly diagrammatic, may often be substituted to advantage, especially if it more clearly illustrates the arrangement of a complicated mechanism.

It is more essential that important facts be clearly stated than that the manuscript be neatly written; but carefully prepared manuscripts usually indicate careful thought.

Avoid describing a mechanism that is familiar to most designers; descriptions of movements that are generally known cannot be accepted, even though they may be very ingenious. It is immaterial how long ago a mechanism or movement was originally designed, provided it has not previously been described in any publication or text-book.

Important Suggestions

Be sure to describe as clearly as possible both the purpose of the mechanism and its action—what it does and how it does it. Describe the purpose first, and the means of accomplishing it afterward.

Confine each article to a description of a single mechanism or mechanical movement. Do not attempt to describe the entire machine of which the mechanism or movement is a part. Clear descriptions of separate mechanisms, rather than descriptions of entire machines are desired. Omit, as far as possible, reference to parts of the machine that do not affect the movement being described.

Do not describe mechanisms that are familiar to most designers. On the other hand, it is immaterial how long ago a mechanism or movement was designed; but it must not have previously been described in any publication or text-book.

* * *

STANDARD COLOR FOR MACHINE TOOLS

The National Machine Tool Builders' Association has adopted a standard color as a finish for machine tools, which will be known as "Standard Machine Tool Gray." This color is a pleasing dark gray tone, exceptionally suitable for machine tools. It is expected that the exhibitors at the Cleveland Machine Tool Show (September 30-October 4) who are members of the National Machine Tool Builders' Association will all have the machines that they exhibit painted with the new standard color. Exhibitors who are not members of the association may obtain a sample plaque of the color from the association's office, 1415 Enquirer Building, Cincinnati, Ohio, so that they may paint their machines in the standard color as well, if they so wish. A color sample will also be furnished to all paint manufacturers upon request, so that they will be in a position to fill orders from machine tool builders for finishes in this color.

At the time that the committee of the National Machine Tool Builders' Association undertook the work of developing a standard color, it was suggested that all exhibitors at the exposition be invited to use this color on the machines or equipment exhibited. If all exhibitors will cooperate in this, it will improve the appearance of the exposition, and it will also aid in informing buyers of machine tools that the machine tool industry, through co-operative action, has adopted a standard color for finishing machine tools.

DIAMETERS AND TOLERANCES FOR GROUND THREAD TAPS—1

Adopted by Tap and Die Manufacturers (Supersedes Data Sheet No. 51)*

U. S. Standard—Ground Threads—Commercial Tolerances for Hand, Nut, and Tapper Taps

U. S. Standard Screw Threads			Tap Measurements—Ground Threads					
Size and No. of Threads	Basic Screw Thread Diameters		Major (Outside) Diameter			Pitch Diameter		
	Major (Outside) Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
1/4–20	0.2500	0.2175	0.2535	0.2550	0.0015	0.2180	0.2185	0.0005
5/16–18	0.3125	0.2764	0.3165	0.3180	0.0015	0.2769	0.2774	0.0005
3/8–16	0.3750	0.3344	0.3795	0.3810	0.0015	0.3349	0.3354	0.0005
7/16–14	0.4375	0.3911	0.4425	0.4440	0.0015	0.3916	0.3921	0.0005
1/2–13	0.5000	0.4500	0.5055	0.5070	0.0015	0.4505	0.4510	0.0005
9/16–12	0.5625	0.5084	0.5685	0.5700	0.0015	0.5089	0.5094	0.0005
5/8–11	0.6250	0.5660	0.6315	0.6330	0.0015	0.5665	0.5676	0.0011
3/4–10	0.7500	0.6850	0.7570	0.7590	0.0020	0.6855	0.6866	0.0011
7/8–9	0.8750	0.8028	0.8830	0.8850	0.0020	0.8038	0.8050	0.0012
1–8	1.0000	0.9188	1.0090	1.0110	0.0020	0.9198	0.9212	0.0014
1 1/8–7	1.1250	1.0322	1.1345	1.1370	0.0025	1.0332	1.0347	0.0015
1 1/4–7	1.2500	1.1572	1.2595	1.2620	0.0025	1.1582	1.1597	0.0015
1 3/8–6	1.3750	1.2668	1.3865	1.3890	0.0025	1.2678	1.2696	0.0018
1 1/2–6	1.5000	1.3917	1.5115	1.5140	0.0025	1.3927	1.3945	0.0018
1 3/4–5	1.7500	1.6201	1.7620	1.7650	0.0030	1.6216	1.6236	0.0020
2–4 1/2	2.0000	1.8557	2.0130	2.0160	0.0030	1.8572	1.8592	0.0020
2 1/4–4 1/2	2.2500	2.1057	2.2630	2.2660	0.0030	2.1072	2.1092	0.0020
2 1/2–4	2.5000	2.3376	2.5140	2.5170	0.0030	2.3396	2.3416	0.0020
2 3/4–4	2.7500	2.5876	2.7640	2.7670	0.0030	2.5896	2.5916	0.0020
3–3 1/2	3.0000	2.8144	3.0150	3.0180	0.0030	2.8164	2.8184	0.0020

A maximum lead error of plus or minus 0.0005 inch in one inch of thread is permitted.

Thread Angle Tolerances

Threads per Inch	Permissible Error in One Half Angle
5 and less	Plus or Minus 20 Minutes
6 to 9	Plus or Minus 25 Minutes
10 to 20	Plus or Minus 30 Minutes

*Larger outside diameters have been adopted to allow for greater wear and the minimum pitch diameters on taps over 3/4 inch have been increased to compensate for lead errors.
The dimensions in this table apply to taps and not to tapped holes.

MACHINERY'S Data Sheet No. 161, New Series, September, 1929

DIAMETERS AND TOLERANCES FOR GROUND THREAD TAPS—2

Adopted by Tap and Die Manufacturers (Supersedes Data Sheet No. 52)*

S. A. E. Standard—Ground Threads—Commercial Tolerances for Hand, Nut, and Tapper Taps

S. A. E. Standard Screw Threads			Tap Measurements—Ground Threads					
Size and No. of Threads	Basic Screw Thread Diameters		Major (Outside) Diameter			Pitch Diameter		
	Major (Outside) Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
1/4–28	0.2500	0.2268	0.2520	0.2535	0.0015	0.2273	0.2278	0.0005
5/16–24	0.3125	0.2854	0.3150	0.3165	0.0015	0.2859	0.2864	0.0005
3/8–24	0.3750	0.3479	0.3775	0.3790	0.0015	0.3484	0.3489	0.0005
7/16–20	0.4375	0.4050	0.4410	0.4425	0.0015	0.4055	0.4060	0.0005
1/2–20	0.5000	0.4675	0.5035	0.5050	0.0015	0.4680	0.4685	0.0005
9/16–18	0.5625	0.5264	0.5665	0.5680	0.0015	0.5269	0.5274	0.0005
5/8–18	0.6250	0.5889	0.6290	0.6305	0.0015	0.5894	0.5902	0.0008
11/16–16	0.6875	0.6469	0.6915	0.6935	0.0020	0.6474	0.6482	0.0008
3/4–16	0.7500	0.7094	0.7540	0.7560	0.0020	0.7099	0.7107	0.0008
7/8–14	0.8750	0.8286	0.8795	0.8815	0.0020	0.8296	0.8305	0.0009
7/8–18	0.8750	0.8389	0.8785	0.8805	0.0020	0.8399	0.8407	0.0008
1–14	1.0000	0.9536	1.0045	1.0065	0.0020	0.9546	0.9555	0.0009
1 1/8–12	1.1250	1.0709	1.1300	1.1325	0.0025	1.0719	1.0729	0.0010
1 1/4–12	1.2500	1.1959	1.2550	1.2575	0.0025	1.1969	1.1979	0.0010
1 3/8–12	1.3750	1.3209	1.3800	1.3825	0.0025	1.3219	1.3229	0.0010
1 1/2–12	1.5000	1.4459	1.5050	1.5075	0.0025	1.4469	1.4479	0.0010

LEAD TOLERANCE

A maximum lead error of plus or minus 0.0005 inch in one inch of thread is permitted.

ANGLE TOLERANCES

Permissible error in one half of the thread angle is plus or minus 30 minutes.

*Larger outside diameters have been adopted to allow for greater wear, and the minimum pitch diameters on taps over 3/4 inch have been increased to compensate for lead errors.
The dimensions in this table apply to taps and not to tapped holes.

MACHINERY'S Data Sheet No. 162, New Series, September, 1929

MACHINERY Sentember 1929 564

Use of Concrete in Machine Construction

Methods of Applying Concrete in Machine Construction and Use of Templets to Obtain Accurate Alignment and Correct Location

By CHARLES B. IRMER

CONCRETE, in addition to its extensive use as a support for machinery and mechanical equipment, is frequently employed in the construction of component parts. When it forms an integral part of an installation, the design should be so planned that the concrete work can be done at a reasonable cost by a contractor experienced in handling the average type of structural work.

As contractors for concrete work seldom, if ever, encounter specifications as exacting as those required in the machine-building industries, the responsibility of adapting concrete construction to a machine part or machinery installation naturally falls upon the machine manufacturer or person in charge of the installation work.

Thus, the machine designer must make suitable provisions for placing all inserts, holes, etc., for the subsequent installation of the equipment, and provide means for locating such details in the concrete with the required accuracy in a minimum of time and with as little interference with the concrete pouring operation as possible..

Machine Embodying Typical Concrete Construction

The present article and a succeeding installment deal with the design and installation of an electro-

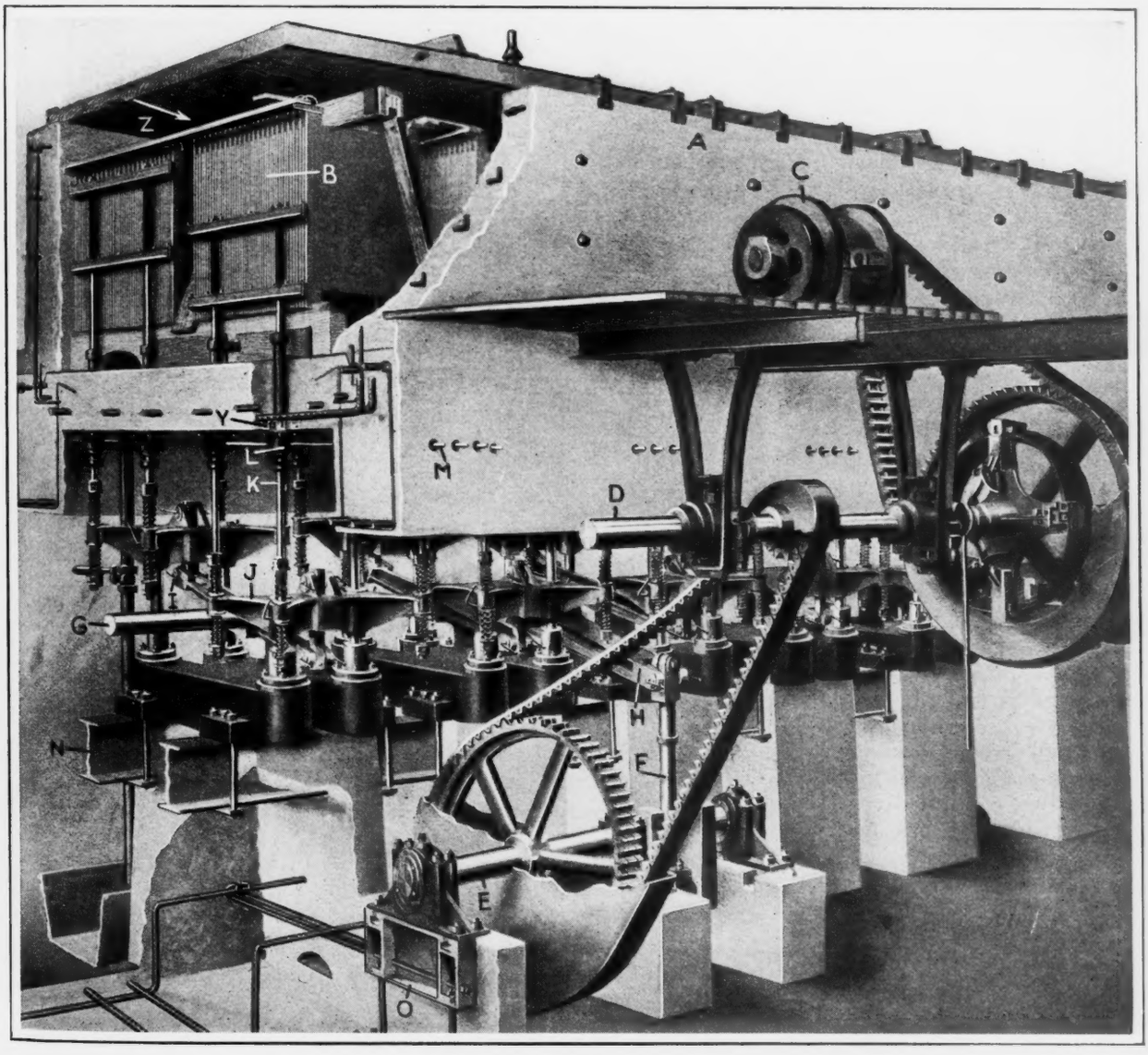


Fig. 1. Machine Installation Incorporating Concrete Construction

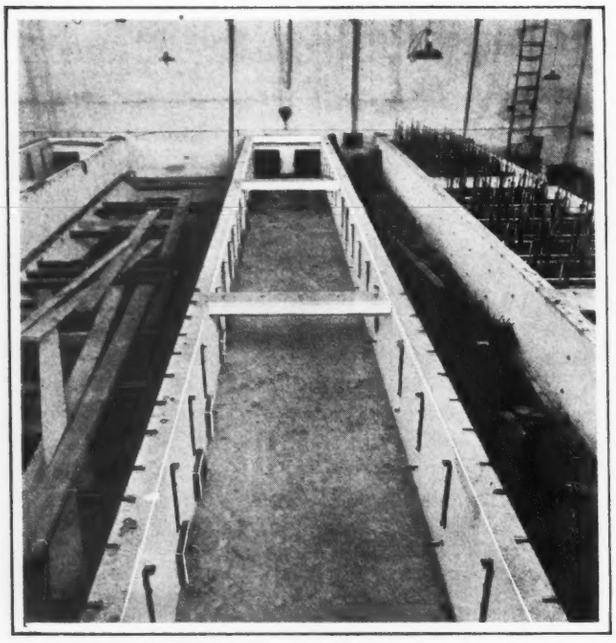


Fig. 2. Concrete Tank of Machine Shown in Fig. 1 as it Appeared before Installing Electrodes

lytic sewage treatment machine, the construction requirements of which are similar to those encountered in designing machines of many kinds. The methods employed have proved satisfactory and should be of interest to machine builders generally. In Fig. 1 is a cross-section view of the machine, which shows clearly how the concrete construction is employed.

The concrete tank *A* is about 50 feet long, 6 feet wide, 3 feet deep, and is supported on columns that raise the bottom of the tank 6 feet above the general floor level. Inside the tank are eighteen banks of electrodes *B*, which are arranged in three longitudinal sets of six banks each, the electrodes being accurately spaced. Each bank of electrodes is made up of ninety plates, spaced 3/8 inch apart. The sewage passes through the machine and comes into contact with the surfaces of the electrode plates, where it is acted upon by the gases of electrolysis liberated in the sewage by the application of an electric current to the electrodes. Between adjacent plates there is a scraper made of insulating material which moves up and down continually. These scrapers keep the passages between the plates clear and serve as mechanical depolarizers.

Transmission of Reciprocating Motion

The principal mechanical problem involved in the installation is the transmission of the desired reciprocating motion to the scrapers. Power for obtaining the oscillating movement is supplied by an electric motor *C* which drives the countershaft *D*. From the countershaft, the motion is transmitted to the crankshaft *E*. There are three crankshafts to a machine, each driving the scrapers in one of the sets of six banks of electrodes. The connecting-rod *F* drives the rocker shaft *G* through the rocker arm *H*, imparting to the shaft an oscillating motion.

To the rocker shaft are secured the six walking beams *I* which move the cross-heads *J* to which are secured the push-rods *K* for operating the scrapers. The push-rods pass through the lower bearings *L* which are secured to the under side of the tank.

Construction of Concrete Tank and Installation of Equipment

Fig. 2 shows a top view of the tank as it appears during construction. The openings in the bottom of the slab are for the push-rods. The attachments on the side walls of the tank are used to secure the electrodes in place. The concrete stiles across the tank divide it into three sections, in each of which are six banks of electrodes.

In Fig. 3 is shown a view of the machinery installed below the tank. This view shows the individual driving units for each bank of electrodes and the method of securing them to the supporting I-beams. It will be noted that the concrete foundation not only serves as a support for the machine, but is also an integral part of it and thus serves to eliminate the necessity for additional machine members.

Outline of Requirements

Careful attention must be given certain details in order to insure the required accuracy in the loca-

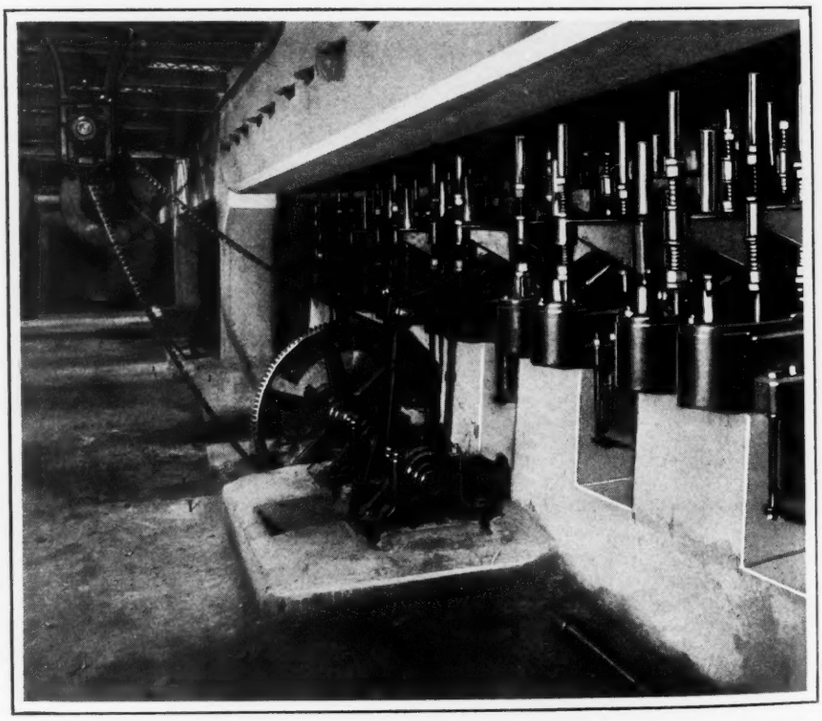


Fig. 3. View of Scraper Reciprocating Machinery Installed below Concrete Tank

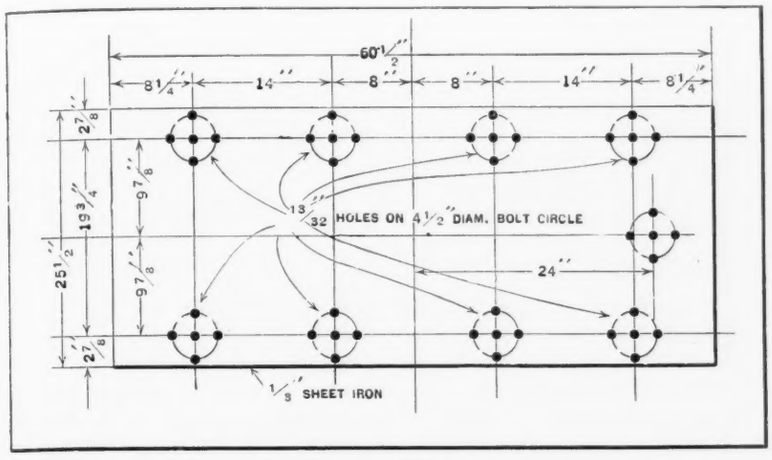


Fig. 4. Templet Employed in Drilling Concrete Forms for Locating Inserts and Cores

tion of the machined elements that are to be held in place by concrete members. An outline of the details requiring special attention should be kept constantly before the designer while the working drawings are being made. In the case of the sewage machine, the principal details were outlined as follows:

1. The spacing of the push-rod holes in the bottom slab of the tank must be correct. The holes for the rods of any one bank of electrodes must be accurately spaced with respect to the center line of the bank and the longitudinal center line of the machine. The holes for the push-rods of the eighteen banks must be correctly spaced longitudinally in order to space the electrodes accurately.

2. Suitable inserts must be provided around each of the cored push-rod holes for securing the bearings to the under side of the tank.

3. Holes must be provided through the beam of the tank for the oil-pipes *M*, Fig. 1, which lead to the lower bearings.

4. The supporting I-beams *N*, Fig. 1, must be the correct distance apart, central with the longitudinal center line of the tank and at the proper distance from the under side of the bottom slab of the tank.

5. The three crankshaft bearings *O*, Fig. 1, must be properly spaced with respect to each other and be at the correct elevation with respect to the under side of the bottom slab of the tank and the top of the supporting I-beam. Every common longitudinal center line must be parallel to, and the correct distance from, the corresponding center line of the tank.

6. A suitable lower bearing which will automatically adjust itself to any slight irregularities of the concrete surface on the under side of the bottom slab is necessary.

The placing of the reinforcing steel in the tank slab, walls, and foundation, as shown in Fig. 1, is easily accomplished, the work being identical with that of conventional reinforced concrete construction. The spacing of the pipe inserts in the side walls for securing the attachments shown in Fig. 2 is done by exercising the usual care in making measurements when the concrete forms are constructed. The methods and equipment used for meeting the requirements outlined will be described in this and a succeeding article.

Forms and Templets for Concrete Work

First the supporting columns for the tank are laid out, forms built, and the concrete poured, the required reinforcing steel being placed prior to the pouring of the concrete. The forms for the bottom slab and beam are constructed, braces on the under side of the bottom slab being spaced to clear the bolts for the inserts and templets to be described later. Eighteen templets like the one shown in Fig. 4 are then placed in approximately the correct position on top of the form for the under side of the bottom slab. These templets have nine sets of five holes each arranged on the centers shown. Eight of the holes are for the push-rods and the ninth hole, which is central with the transverse center line of the templet, is for a drain valve.

For lining up the templets, a piano wire is stretched tightly along the center line of the bottom slab at a position just high enough to clear the templets. The templet for the first bank of electrodes is then carefully set up with its transverse center line the correct distance from the end of the tank at which the installation is started and also in the correct position with respect to the longitudinal center line indicated by the piano wire. The latter spacing is obtained by the use of centering bars like the one shown in Fig. 5, which is provided with plugs fitting into the holes in the templets and thus serving to establish the proper location when the V-notch is directly below the piano wire.

After the templets are set, all the holes are drilled in the wooden form with an electric drill. To the central hole of each group of four holes is secured a tin can of the proper diameter and depth to core

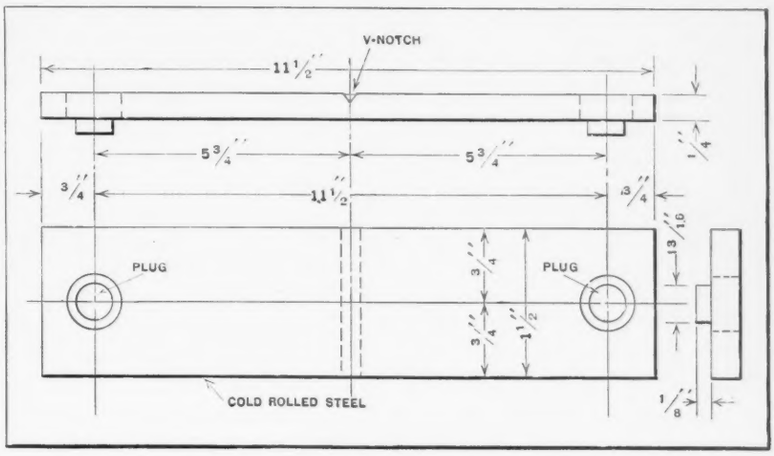


Fig. 5. Bar Used in Spacing and Centering Templets Like the One Shown in Fig. 4

the desired hole in the bottom slab for the grease tube of the lower push-rod bearing. The hole for the drain valve is also cored in the same manner.

To each of the four holes surrounding the central holders of the templet is secured an insert of the type shown at *Y*, Fig. 6, with a 13/32-inch punched hole in it. One of these inserts is shown in the completed structure, Fig. 1. The size of this insert is such that a 3/8 U. S. Standard nut is a good fit between the vertical sides. The insert and templets are bolted in place on the form, the bolts being inserted from the under side of the form for the slab. Plan and section views of the assembled inserts as they appear in the tank are shown in views *A* and *B*, Fig. 6.

After the templet for the first electrode is set, the other templets are set up in a similar manner, the longitudinal spacing being obtained from the previously set templet by means of bars similar to the one shown in Fig. 5, but having the proper spacing between the locating plugs. Bars like the one shown in Fig. 5 are, of course, used in all cases for lining up the templets with the piano wire. It is thus possible to set all the templets without making field measurements other than those required for setting the initial templet of each machine. The lay-out, construction, and installation work required to complete the machine will be described in a succeeding article.

* * *

INSTRUMENT INDICATES TEMPERATURE OF AIRPLANE ENGINES

An indicator that gives the temperature of aircraft engines has been developed by the General Electric Co., Schenectady, N. Y., for laboratory experimental work and for general service. This device is a cold-junction, temperature-compensated instrument consisting of a thermo-couple with its leads and a remote indicating instrument calibrated to read engine heat. When mounted in the cylinder heads and walls of aircraft engines, it will indicate the engine temperature at any desired point. One of the principal features of the device is a provision which obviates the necessity of making corrections for changes in ambient temperature.

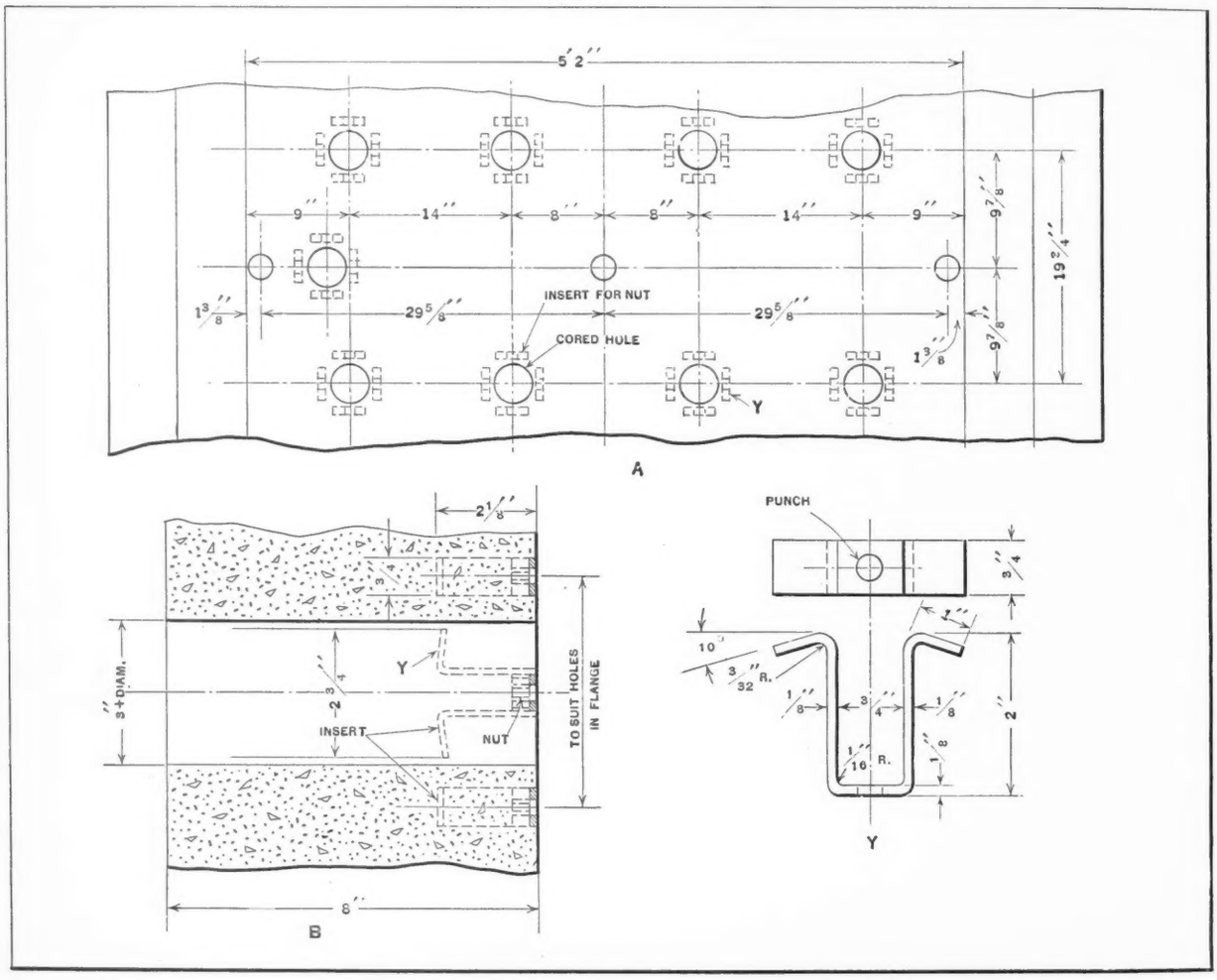


Fig. 6. (A) Plan View of Bottom of Concrete Tank, Showing Cored Holes and Inserts with Nuts for Securing Bearings; (B) Enlarged Section View of Shaft Hole Cored in Concrete Slab; (C) Detailed View of Insert for Nut

* * *

The exports of American industrial machinery during the first half of 1929 amounted to $130,000,000, as compared with $102,000,000 for the corresponding period of 1928.

Conducting Successful Foremen Conferences

Some of the Fundamental Rules that Should be Observed in Planning Foremen Conferences to Obtain the Best Results

IN the articles on foremen conferences that have been published in MACHINERY, May, June, and July, 1929, the aims and purposes of these conferences have been outlined and the results obtained have been briefly covered. In the following paragraphs a few general suggestions relating to the details that must be observed in organizing and conducting foremen conferences will be given.

The Conference Room and Its Equipment

As a result of considerable experience with foremen conferences, the following rules relating to the type of room and equipment best suited have been laid down. Use a medium-sized, quiet, light, and well ventilated room, with comfortable chairs arranged in a half circle. Every effort should be made to keep away from the schoolroom atmosphere. It is preferable to permit smoking during the conferences, as this adds to the informal character and seems to help some men to "be themselves." The room should be so located that there will be freedom from interruptions. It should have no telephone. It should be provided with a good-sized blackboard, and also with large sheets of paper for reference notes.

The conferences should consist mainly of foremen, fifteen to twenty making an ideal group. All departments should be represented, as far as possible. Most plants hold these foremen's meetings once a week, and experience at different plants indicates that the best hour is from 10 to 11 A. M. However, the problems to be discussed and the general outline of the topics has a great deal to do with the time. For example, some foremen seem to think about their departmental problems better in overalls than in white collars; on the other hand, when the topics relate to the general problems of the industry, it seems better to meet in the evenings. In larger communities, however, evening meetings are not convenient, but in small communities they may be very desirable.

Some Difficulties in Conducting Foremen Conferences

The conference leader must have considerable tact in dealing with the assembled group. Frequently there are personal disagreements between two or more members of the conference, which may become very heated. Such arguments may, perhaps, be best broken up by the leader telling a timely story to clear the atmosphere. Then again, the group may "get off" the subject and begin an animated discussion of some other topic in which it seems to be more interested. An antagonistic or skeptical group is always difficult to handle, and so is a group that shows lack of interest in the subject. In that case it is often well to suggest that the men select another topic which may seem more important. Political or religious differences sometimes crop up, and it is well to set up a conference policy in advance barring topics that are purely personal. Then a reminder on the part of the leader will often prevent discussion of such subjects.

Very often the group includes a man who is inclined to talk too much and who trys to dominate the discussions. It is generally better for the men to handle such a member than for the leader to try to curb his loquacity. It may be well to set up as a rule for all conferences that individual statements must be limited to a certain number of minutes. Then if the conference as a whole wishes to extend the time, this can be done.

What Have Foremen Conferences Accomplished?

In one plant where 140 foremen took part in conferences for over a year, the men in the different groups were asked to state briefly what they considered had been accomplished. On the basis of the replies, the advantages of such conferences may be summarized as follows:

They make it possible for the foremen to become better acquainted, and in that way increase their willingness to cooperate with one another, making them more efficient as a body. These conferences have also brought about a better understanding between the shop and the engineering and business offices, and have enabled the foremen to see more clearly the other man's viewpoint. They have given the foreman a better knowledge of his duties, and broadened his ideas by the exchange of views.

Further, a better understanding of the company's problems and policies and of the costs involved in running a plant is obtained. In this way, these conferences have aided in decreasing expenses, speeding up production, and reducing complaints from customers due to broken promises in regard to deliveries. There has also been a reduction in the number of accidents, as this subject has been strongly emphasized in the conferences.

As to the foremen personally, the conferences have given them greater confidence in themselves. They have stimulated them to think and prepare themselves for promotion, by training them in leadership and fitting them for the managerial problems of the future.

* * *

By grouping recording instruments such as voltmeters, tachometers, etc., on a board and photographing the group at definite intervals, a permanent record may be obtained for future reference. Photography may also be utilized for recording progress in the building of industrial machinery.

Universal Air Cylinder for Milling Machine

Design of Air Cylinder which May be Applied to the Operation of a Variety of Milling Fixtures Already Built

By J. E. FENNO

AIR-OPERATED fixtures, up to the present, have not been very widely used on milling machines, especially where the work is handled in small lots. This is due, no doubt, to the high cost of fixtures equipped with individual air cylinders. In lathe chucking work, it is common practice to locate the air cylinder on the end of the spindle, the same cylinder being used to actuate several types of chucks and chuck jaws. Somewhat the same idea, differing in that the work is clamped and released automatically without operating an air valve, has been adapted to a hand miller.

The advantage of this equipment (Fig. 1) is that it can be applied, with slight modifications, to many hand-operated fixtures already in use. This method of operating tools, besides being quicker, also insures uniform clamping pressure, thus resulting in accurate work.

Single Air Cylinder for all Fixtures

Referring to Fig. 1, the air cylinder unit is mounted on the end of the table in a manner that will not reduce the capacity of the machine to any great extent. The piston-rod *E*, at the end outside

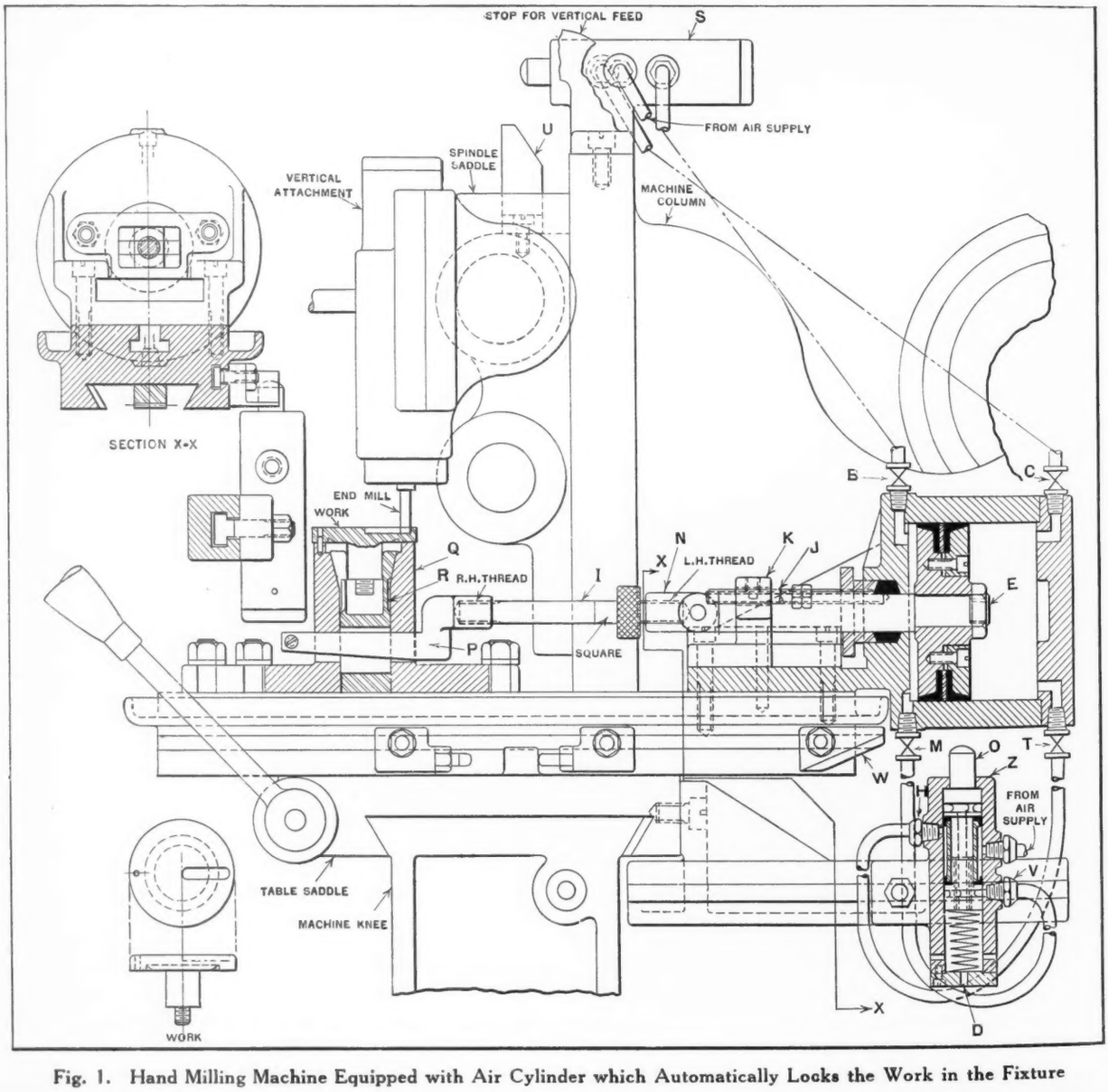


Fig. 1. Hand Milling Machine Equipped with Air Cylinder which Automatically Locks the Work in the Fixture

the cylinder, is held securely in sliding member *K*. The latter, sliding freely in the cylinder base, provides the necessary outboard support for the piston-rod when in the position shown. A knuckle *N*, hinged to the end of the piston-rod, is connected to the fixture wedge *P* by the rod *I*. The design of this knuckle permits connecting-rod *I* to be set at an angle, a necessary condition for certain types of fixtures which will be described later.

The work is held securely in the fixture by means of the spring collet *R*. The latter is operated through the action of the sliding wedge *P* against the bottom of the slot in the collet. The wedge, in turn, receives its motion from the air cylinder unit through the connecting-rod *I*. On the two stop-rods *J*, screwed into the cylinder, are check-nuts which act as stops against the slide *K*, to shorten the stroke of the piston as required.

In order to clamp the work automatically in the several types of fixtures used, it was necessary to incorporate the two valves *Z* and *S*, which are connected to the cylinder by flexible tubing. Both these valves are identical except for the manner of mounting them on the machine.

For milling the work shown, valve *S* only is operated, the cocks *M* and *T* being closed. This valve is operated by dog *U*, the angular face of which forces the plunger in when the spindle saddle is up or in the loading position. The depression of this plunger causes air to enter on the left side of the piston, thus carrying the piston-rod to the right and releasing the wedge *P*, which allows the work to be removed. Another piece of work is then loaded into the fixture and the saddle moved down. This releases the valve plunger, allowing air to flow into the right-hand side of the piston, which forces the piston-rod and wedge *P* to the left, thus clamping the work in the fixture. The exhaust air is expelled from the valve through holes similar to those shown at *D*.

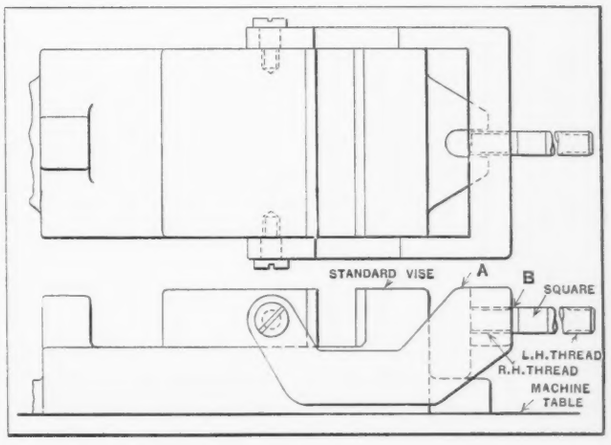


Fig. 3. Standard Vise Adapted for Operation by Compressed Air

Since valve *S* cannot be operated when the spindle saddle is locked, as, for example, when milling completely through the work as shown in Fig. 5, valve *Z*, Fig. 1, is used. In that case, cocks *B* and *C* are closed and those at *M* and *T* opened. Dog *W* and the valve are adjusted, so that when the table is carried back to move the work away from the cutter, the dog will depress the plunger *O*. The action of the piston is the same as when using valve *S*. Sometimes the working pressure may be required in the opposite direction from that shown. In that case the tubes at *V* and *H* are exchanged. The same method may be used on valve *S*. The following examples will show typical applications of this device.

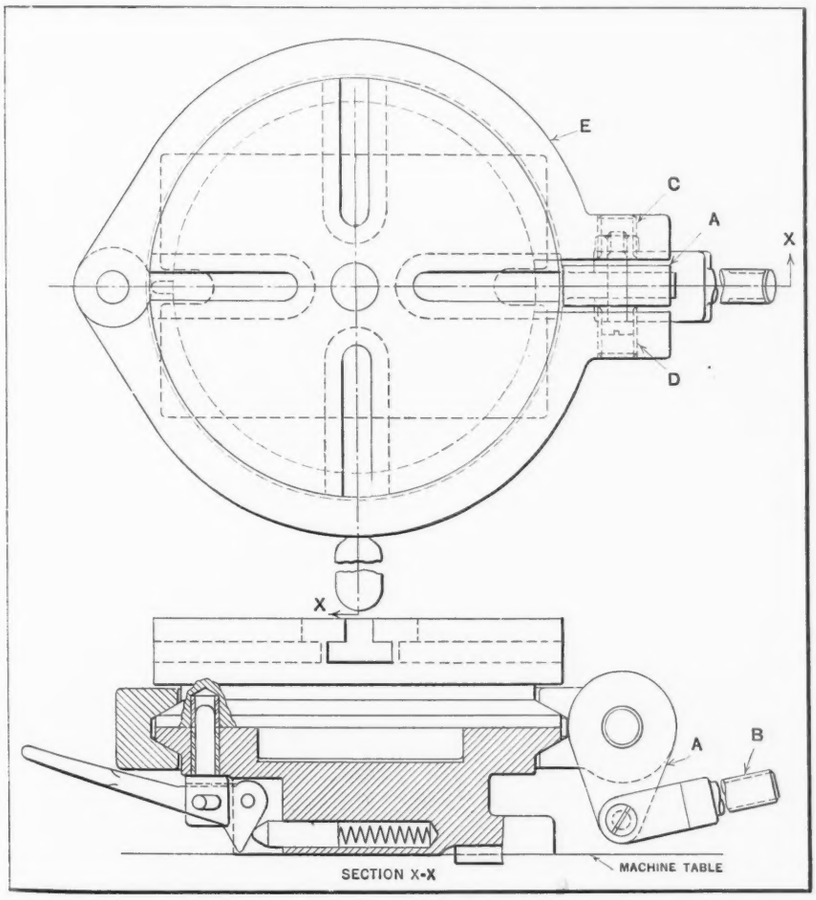


Fig. 2. Air Cylinder Applied to Indexing Plate, Previously Hand-locked

Air Cylinder Applied to Indexing Plate and Standard Vise

The indexing fixture shown in Fig. 2, which is used on hand milling machines for general work, was originally designed to be locked by means of a hand-lever. This lever is now replaced by the lever *A* and the connecting-rod *B*, which permits the fixture to be used with the air cylinder unit, the threaded end of rod *B* being screwed into the piston-rod

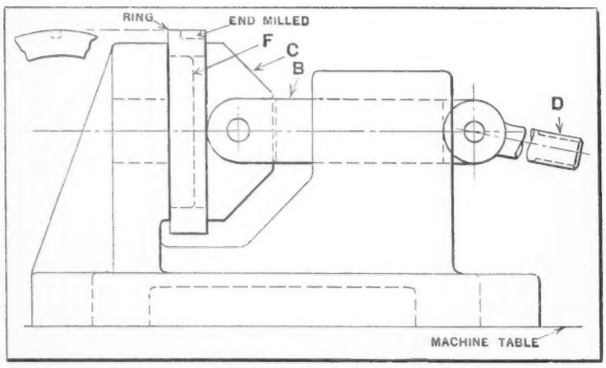


Fig. 4. Air-operated Fixture for Milling Slot in Collar

knuckle. The projections *C* and *D* on lever *A* are threaded right- and left-hand, respectively, so that the action of the piston will close the split ring *E* and clamp the index table rigidly.

In Fig. 3 is shown a standard vise with the regular tightening screw removed. Fastened to the sliding jaw by shoulder screws is the bracket *A* which, in turn, is connected to the piston-rod knuckle by the rod *B*. This type of vise can be employed, by the use of special jaws, for holding work of many different shapes. The quick-acting feature is evident.

A fixture of simple design, for use with the air unit, is shown in Fig. 4. The ring to be end-milled is centered on the plug *F*. The clamp *C*, through the action of the air unit on connecting-rod *D* and plunger *B*, holds the ring securely. Sufficient clearance is allowed between the clamp in its open position and the plug to permit the loading and removing of the work.

The fixture shown in Fig. 5 is also of simple construction. The work is a dovetailed slide and has a boss through which a slot is to be milled. The clamping is accomplished by the threaded projections on link *B*, the latter receiving its motion from the air unit through the rod *D*. The application of a unit similar to that described in Fig. 1 to power feed milling machines should also be possible.

* * *

American exports of portable pneumatic tools have increased steadily during the last few years. In 1928 they amounted to more than $1,700,000, as compared with about $1,555,000 in 1927 and $1,158,000 in 1925. The best customer was the United Kingdom, which took about 27 per cent of the total in 1928.

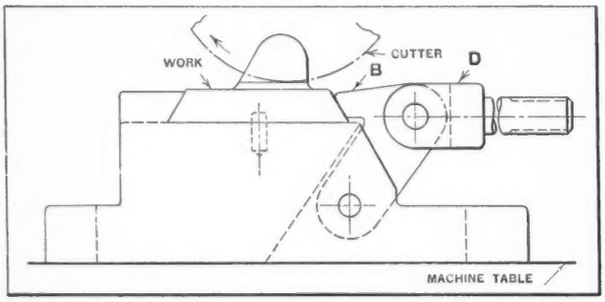
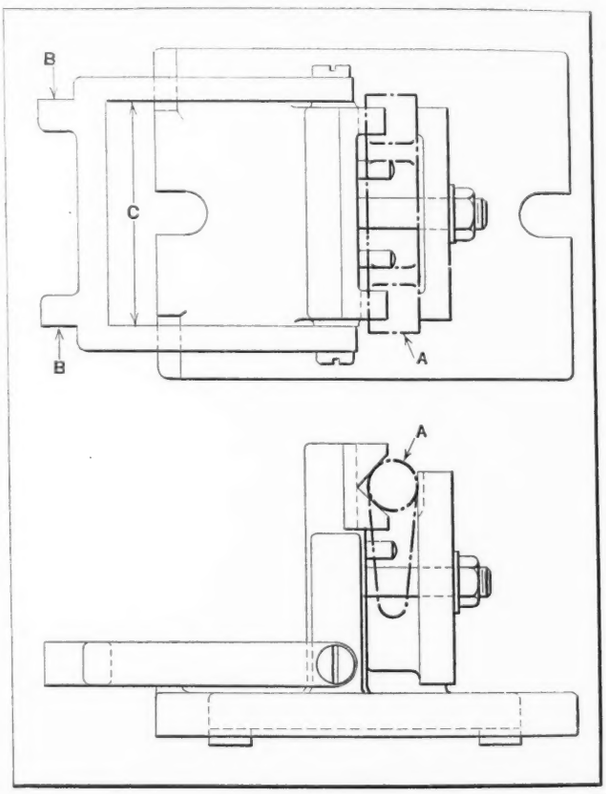


Fig. 5. Another Example of an Air-operated Fixture

FIXTURE WITH GAGE FOR SETTING CUTTERS

By SVEND J. HELWEG

Much lost time would be saved and the spoilage of work prevented if tools and fixtures were provided with setting-up gages. In the accompanying illustration is shown a common milling fixture for straddle-milling the part shown by heavy dot-and-dash lines at *A*. This part is clamped in the fixture in the usual manner, and the setting-up gage *B* dropped down, as shown, so that it clears the cutters. In setting up this fixture, the gage is raised to an upright position and the milling machine table moved in and out until the cutters easily pass over the short extension arms or locating surfaces *B*. The gage is then dropped back out of the way,



Milling Fixture Provided with Gage for Setting Cutters and Testing Work

the table raised to the proper height and locked in position, making the fixture ready for use.

The inner sides of the gage are finished to permit gaging the length of the work *C*. Another method of setting fixtures of this kind is to use a part of the same general outline as that to be machined. This part is clamped in the fixture and the machine adjusted until the cutters are properly lined up.

* * *

Over 50 per cent of Poland's imports of industrial machinery, tools, and equipment come from Germany. The imports of American machinery, however, have grown steadily during recent years. In 1926 they were valued at only $256,000, while in 1927 they amounted to $1,150,000.

LAPPING BALL-BEARING RACEWAYS

By H. J. WILLS, Engineer, The Carborundum Co., Niagara Falls, N. Y.

Ball-bearing raceways in cups and cones of all modern high-speed machines require lapping to produce a finish that is absolutely free from grinder "fuzz," surface waves, and chatter marks. It is not possible to procure these ideal conditions by grinding alone, but if the grinding machine is equipped with ball bearings, or with plain bearings that have been lapped, a much better ground finish can be obtained, which will have a very definite effect on reducing the time required for subsequent lapping. A slight deviation from perfection in the grinding machine will cause the presence of chatter marks or synchronous waves in the raceways, which obviously precludes quiet operation.

Microscopic examination of ground raceways indicates that "fuzz" is due to either loose or semi-detached metal particles which, though they may resist the ordinary cleaning before the bearing is assembled, will promptly separate under the mechanical action of a ball in motion. Examination of unlapped raceways before and after a load test has shown that these minute metal particles have affected the ball surfaces and that the ever present chatter marks or waves have been rolled over or burnished by the balls under fairly light loads, causing an immediate wear or play of from 0.0001 to 0.00025 inch, depending on the quality of the grinding.

The fact that raceways for all high- and most moderate- and low-speed ball bearings are now being lapped is a strong indication that the principles stated in the foregoing are accepted. In the industry, however, there is a wide divergence of opinion as to just what constitutes good lapping practice, the degree of finish necessary, and the type of lapping compound that should be used.

Raceways may be lapped to a finish where no grain marks are visible under a low-power glass and yet be noisier in operation than an unlapped surface. A good appearing surface, while not essential, is a desirable feature if combined with quiet operation; but shallow grain lines do not, in themselves, prove poor lapping practice. If, then, the appearance of a raceway is of secondary importance, it is reasonable to assume that the primary object in lapping should be, first, to remove any chatter marks or waviness caused by a synchronous distortion of the grinder elements; and, second, to remove any grinder "fuzz." Obviously, if the first object is accomplished, the second must be.

Methods of Lapping Different Types of Raceways

There are several different methods of lapping ball-bearing raceways, but all are essentially the same. The raceways are turned at speeds of between 2300 and 2600 surface feet per minute while a stationary lap is pressed firmly into the groove. Faster speeds will tend to cause vibration, and beyond a certain speed, the abrasive grain is not given a chance to perform its work. As an example of this, it has been demonstrated in one plant that the reducing of the machine speed 50 per cent resulted in a 40 per cent saving in the time required for lapping.

For lapping poorly ground and chatter-marked raceways or very large raceways, Carborundum Brand finishing compound in the grading WL3-4 may be applied with a lap made of white wood. A very heavy pressure should be exerted on the lap at first, and this should be gradually lightened as the lapping action progresses.

In lapping raceways that present a fairly good surface after grinding, either a white-wood or a chrome-tanned leather lap is used with finishing compound in the grading WO3-4. A constant heavy pressure should be maintained on the lap throughout the operation.

When the ground raceway surface presents a high finish and when an extremely accurate and good appearing raceway is demanded, it is recommended that finishing compound in the grading WO3-4X be applied with a hard white Mexican felt lap. An even heavy pressure should be maintained throughout the lapping process.

For lapping very small types of raceways, WR3-4 Carborundum Brand finishing compound will give very satisfactory results. Any one of the laps described in the preceding may be used, depending on the finish of the raceway after grinding.

Tools Used in Lapping Raceways

The tools for holding the laps may consist of expanding or contracting pliers. In some cases, the lap is attached to what is known to the trade as a "joy stick." This type of tool is used only when lapping outer raceways. When lapping inner raceways, a lap of strip form is used and held in position by hand. The lap should be made so as to provide for at least a 35-degree arc of contact which will materially lessen the time required for removing any waviness in the surface of the raceway.

Thrust bearing raceways may be successfully lapped with a lap formed by tacking chrome-tanned leather around a circular wooden block, the outer radius of which is the same as the inner radius of the raceway. The leather used for this purpose should be pliable enough to be self-locating in the raceway groove.

Cleaning the Raceways after Lapping

Cleaning the raceways after lapping may be done by hand or machine methods, with hot water or kerosene. In some of the larger plants, the following washing solution has given excellent results: 5 per cent of 50 per cent sulphonated castor oil; 40 per cent water; and 55 per cent kerosene. When this solution is used, the raceways retain a sufficient amount of oil to act as an effective anti-rust coating. The solution should be heated, if possible, and if the parts are washed in tanks, it is advisable to have a second tank which is used for rinsing purposes only.

The National Metal Congress and Exposition

Unusual Technical Program, and an Exposition Comprising the Latest Products of Over 250 Metal and Metal Equipment Manufacturers

THE National Metal Congress and the National Metal Exposition both are to be held in Cleveland from September 9 to September 13, inclusive. The organizations that will participate in the National Metal Congress are the American Society for Steel Treating; the American Welding Society; the Iron and Steel Division and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers; and the Iron and Steel Division of the American Society of Mechanical Engineers. In connection with the National Metal Exposition, which will occupy 80,000 square feet in Cleveland's Public Auditorium, there will be displayed the latest products of over 250 metal and metal equipment manufacturers.

An unusually valuable technical program has been prepared both by the American Society for Steel Treating and by the other organizations in the National Metal Congress. The papers to be presented before the American Society for Steel Treating will include many timely subjects, some of which are listed in the following: "Methods of Tests for Determining Machineability of Metals in General, with Results," by O. W. Boston, University of Michigan; "Some Notes on the Behavior of Carbon Tool Steel in Quenching," by G. V. Luerssen, Carpenter Steel Co.; "The Selection of Casehardening Steels for Highly Stressed Gears," by H. W. McQuaid and O. W. McMullan, Timken Detroit Axle Co.; "A Study of the Nitriding Process," by V. O. Homerberg and J. P. Walsted, Massachusetts Institute of Technology; "A Few Fundamentals of the Nitriding Process," by H. W. McQuaid and W. J. Ketcham, Timken Detroit Axle Co.; "Researches on Nitriding Steels," by Dr. O. E. Harder, J. T. Gow, and L. A. Willey, University of Minnesota; "Short Time Nitriding of Steels in Molten Cyanides," by A. B. Kinzel and J. J. Egan, Union Carbide and Carbon Research Laboratories; "Investigations in Nitriding," by Robert Sergeson, Central Alloy Steel Corporation; "Observations upon the Iron-Nitrogen System," by Samuel Epstein, Illinois Steel Co.; "The Economical Refuse of Solid Carburizing Materials," by H. B. Knowlton, International Harvester Co.; "On the Distribution of Hardness Produced by Cold Working," by W. P. Sykes, Cleveland Wire Works, General Electric Co., and A. E. Ellsworth, Thompson Products Co.; "Production of Electric Steel for Castings," by George Batty, Steel Castings Development Bureau; "Hot Aqueous Solutions for the Quenching of Steel," by H. J. French, Research Laboratory, International Nickel Co., and T. E. Hamill, United States Bureau of Standards; "Development of High-test Cast Irons," by E. J. Lowry, Consulting Metallurgist; "Preparation of Microsections of Tungsten Carbide," by S. L. Hoyt, General Electric Co.; "Overheating of Steel for Forging," by W. E. Jominy, University of Michigan; "Inherent Hardenability Characteristics of Tool Steel," by B. F. Shepherd, Ingersoll-Rand Co. There are to be many other valuable technical contributions.

A plant inspection program is another important feature of the National Metal Congress. This will include visits to such important industrial enterprises as the White Motor Co.; Warner & Swasey Co.; American Steel & Wire Co., (Cuyahoga Works); National Acme Co.; Hupp Motor Car Corporation; Great Lakes Aircraft Corporation; Cleveland Tractor Co., and about fifteen other interesting plants.

The following concerns manufacturing machinery, tools, shop equipment, and materials are to be among the exhibitors at the exposition:

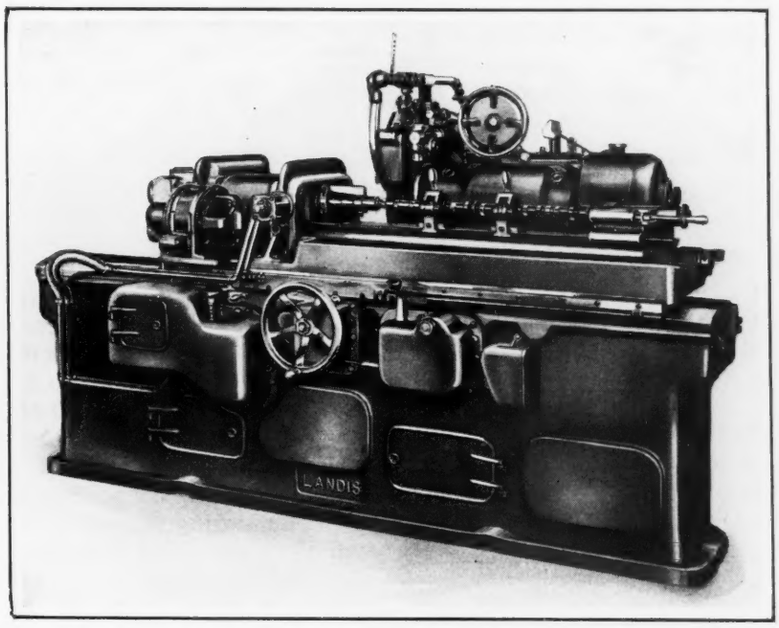
Abrasive Co.
Air Reduction Sales Co.
Aluminum Company of America
American Brass Co.
American Car & Foundry Co.
American Electric Furnace Co.
American Gas Furnace Co.
Ampco Twist Drill Co.
Armstrong-Blum Mfg. Co.
Armstrong Bros. Tool Co.
Automatic Temperature Control Co.
Bausch & Lomb Optical Co.
Bellevue Industrial Furnace Co.
Bethlehem Steel Co.
Bourne-Fuller Co.
Bristol Co.
Brown Instrument Co.
Calorizing Co.
Carboloy Co., Inc.
Carborundum Co.
Carpenter Steel Co.
Case Hardening Service Co.
Central Alloy Steel Corpn.
Chrobaltic Tool Co.
Cleveland Twist Drill Co.
Clipper Belt Lacer Co.
Coats Machine Tool Co., Inc.
Colonial Steel Co.
Columbia Tool Steel Co.
Dardelet Threadlock Corpn.
Disston & Sons, Inc., Henry
Driver-Harris Co.
Duraloy Co.
Duriron Co.
Federal Machine & Welder Co.
Ferner Co., R. Y.
Firth-Sterling Steel Co.
Fusion Welding Corporation
Gas Products Corporation
General Electric Co.
Gibb Welding Machines Co.
Halcomb Steel Co.
Harrington Co.
Harris Calorific Co.
Haynes-Stellite Co.
Houghton & Co., E. F.
International Nickel Co.
Jessop Steel Co.
Jones & Laughlin Steel Corpn.
Keller Mechanical Engineering Corporation
Keystone Lubricating Co.
K-G Welding & Cutting Co.
Leeds & Northrup Co.
Leitz, Inc., E.
Lincoln Electric Co.
Linde Air Products Co.
Ludlum Steel Co.
Metal & Thermit Corporation
Midvale Co.
Milwaukee Die Casting Co.
Morse Twist Drill & Mach. Co.
New Jersey Zinc Co.
Norton Co.
Olsen Testing Machine Co., Tinius
Page Steel & Wire Co.
Pels & Co., Henry
Pittsburgh Instrument & Machine Co.
Production Machine Co.
Reeves Pulley Co.
Riehle Bros. Testing Machine Co.
Rockwell Co., Stanley P.
Roebling's Sons Co., J. A.
Rotor Air Tool Co.
Ryerson Co., Joseph T.
Safety Equipment Service Co.
Scherr Co., Inc., George
Shawinigan Products Co.
Shore Instrument & Mfg. Co.
Simonds Saw & Steel Co.
Southwark Foundry & Machine Co.
Stoody Co.
Strong, Carlisle & Hammond Co.
Surface Combustion Co.
Thompson Grinder Co.
Torchweld Equipment Co.
Una Welding & Bending Co.
Vanadium Alloys Steel Co.
Van Dorn Electric Tool Co.
Weldit Acetylene Co.
Westinghouse Elec. & Mfg. Co.
Wheelock, Lovejoy & Co., Inc.
Wickwire Spencer Steel Co.
Willson Products, Inc.
Wilson-Maeulen Co.

New Machinery and Shop Equipment

A Monthly Record of New Metal-working Machinery, Tools, and Devices for Increasing Manufacturing Efficiency and Reducing Costs

LANDIS SEMI-AUTOMATIC HYDRAULIC CAM GRINDER

A 5- by 40-inch cam grinding machine so designed as to enable one operator to run three or four machines is being introduced on the market by the Landis Tool Co., Waynesboro, Pa. Among the principal features of this machine are a hydraulically controlled timing mechanism; a hydraulic work-carriage traverse; a hydraulic wheel feed; a hydraulic wheel-truing fixture; a hydraulically controlled work cradle; an automatic slow-down control of the work rotation; a 24-inch diameter grinding wheel; an end drive to the grinding-wheel spindle through multiple V-belts; and a reciprocating spindle mechanism of new design.



Landis Hydraulic Cam Grinding Machine Designed to Enable One Man to Run Three or Four Machines

Although the machine is referred to as being semi-automatic, it is fully automatic after the grinding cycle for the first cam on a shaft has begun. In operation, the operator simply fastens a dog on the camshaft, places it in the machine, throws the quick-acting work-rest jaws into position, starts the work rotating by moving a lever, and throws in the main control lever. With the moving of the main control lever, the work carriage brings the first cam into the grinding position, at which point the latch on the front of the bed drops into the first notch of a hardened plate on the front of the carriage. Immediately, the oil pressure is cut off from the carriage traversing cylinder and oil enters the hydraulic straight in-feed cylinder, causing the wheel base to feed in rapidly. At the same time, the oil pressure is reversed in the work cradle cylinder, causing the cradle to swing back until the master cam comes into contact with the roller.

By this time the grinding wheel has come into contact with the work, and the rate of the feeding-in movement is slowed down to the predetermined grinding speed until the wheel-base comes against a positive stop, indicating that the work has been ground to size. Shortly before the end of the cut, the work speed is automatically slowed down, but the fast work speed is again resumed as soon as the cam is finished.

When the first cam has been ground to size as described, the timing cam, which has made one complete revolution, trips the latch and causes the wheel-base to move back rapidly to its starting position. The cradle swings forward and the table traverses to bring the second cam on the shaft into the grinding position, where it is held by the latch entering the second notch in the notched plate. At the same time, the master cam roller is automatically indexed, bringing it in line with the second cam on the master. From this point on, the cycle of operations is exactly the same as in the first case, and is automatically repeated for each cam on the shaft being ground, including the fuel pump cam, if one is used.

When the last cam on the shaft is finished, the wheel-base moves to its extreme rear position, the work cradle swings away from the roller, and the carriage moves a short distance, throwing out the main control lever. This stops all movements except the work rotation, which is stopped by the operator prior to unloading the machine. After the operator has started the first machine, he has ample time to reload and start two or three other machines, before the first is ready for unloading.

Shafts may be ground from left to right or from right to left without changes of any kind, as the automatic movements function with the work carriage traversing in either direction. Little time is lost in truing the grinding wheel, because of the hydraulic drive provided for the truing diamond, and the wheel may be trued without disturbing the work, regardless of the position of the work carriage. The setting of the diamond need not be

distributed after truing, and so it is always ready for use.

Two motors are used to drive the machine, the main drive motor being of 15 horsepower rating and the work-drive motor of 1/2 horsepower capacity. Provision has been made for mounting a direct-current generator on the machine in case direct current is not available. The net weight is 10,000 pounds, including both motors.

SOCIETE GENEVOISE JIG BORING MACHINES

New models of the Nos. 4 and 5 jig boring machines built by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, are now being placed on the market in the United States and Canada by the R. Y. Ferner Co., Investment Building, Washington, D. C. These machines, which are now designated MP4B and MP5B, respectively, are based on the same fundamental principles as the older types; however, numerous improvements are embodied. The MP4B machine is shown in Fig. 1, while the MP5B borer is illustrated in Fig. 2.

Various parts have been strengthened to make possible the use of greater power and thus increase the speed of operation and the drilling and boring capacity. The weight of the vertical housings has been increased, as well as the weight of the tool-slide and boring heads, and a new ribbed design has been adopted for the cross-rail. The diameter of the quill in the main boring head has been increased, and is machined to receive No. 4 Morse taper shanks, the same boring head being used on both machines. The feed of the spindle is now 7 inches. An oil-pump for lubricating the main spindle, with a sight drip feed controlled by a needle valve, is provided, and there is a sight-feed oiler on the high-speed spindle.

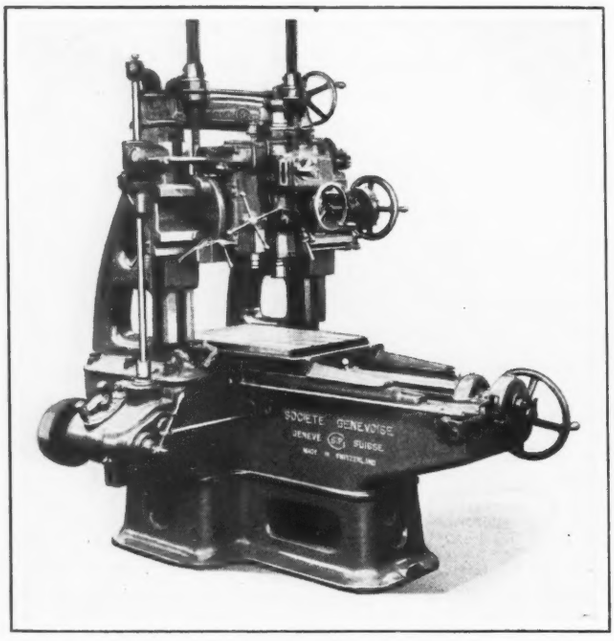


Fig. 1. Societe Genevoise Jig Boring Machine of Recently Improved Design

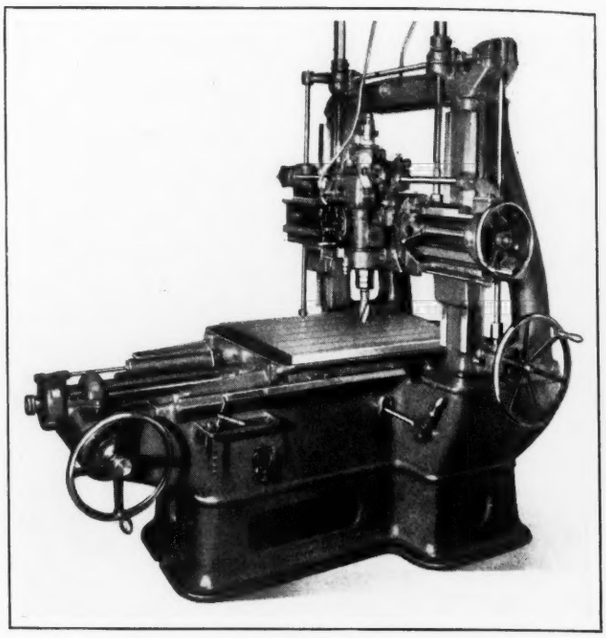


Fig. 2. View of Jig Boring Machine Illustrating Increased Width and Other Features

The size of the high-speed spindle has been increased to permit the use of No. 1 Morse taper shanks, which avoids the necessity of using collets for straight-shank tools. The drilling and boring capacity of the high-speed spindle is, therefore, increased and now covers a range of from 3/64 to 1/2 inch. This spindle has nine speeds, ranging from 212 to 1870 revolutions per minute. The nine-speed range of the main spindle has also been changed, now being from 45 to 400 revolutions per minute. The main spindle has a drilling capacity up to 1 3/4 inches in cast iron and 1 1/4 inches in soft steel, while the boring capacity is 6 inches.

In eliminating the use of collets in the high-speed spindle, a new form of holder has been adopted for the guide bushings which keep the ends of drills from vibrating. This new holder makes it easier to insert the guide bushings and tools. Guide bushings up to 5/16 inch are provided, as well as a Jacobs chuck having a capacity up to 1/4 inch for straight-shank tools. Among the new accessories supplied is an adjustable boring tool with a capacity up to 3/4 inch, and there is an extra boring tool having a capacity of from 4 to 6 inches. An adapter is provided to accommodate drills and end-mills with No. 2 taper shanks in the main spindle.

The distance between the vertical housings has been increased on both machines to admit larger pieces of work and the table has been widened to allow another T-slot to be added. The method of attaching the rectangular table to the nut on the lead-screw has been simplified. Improvements have also been made in the circular tables provided with the machines. Their height has been increased sufficiently to permit sliding them to any point on the rectangular table or on a work-bench, without interference from the handle of the worm-screw. The shaft of the worm-screw is now designed to permit quick attachment of any one of a set of

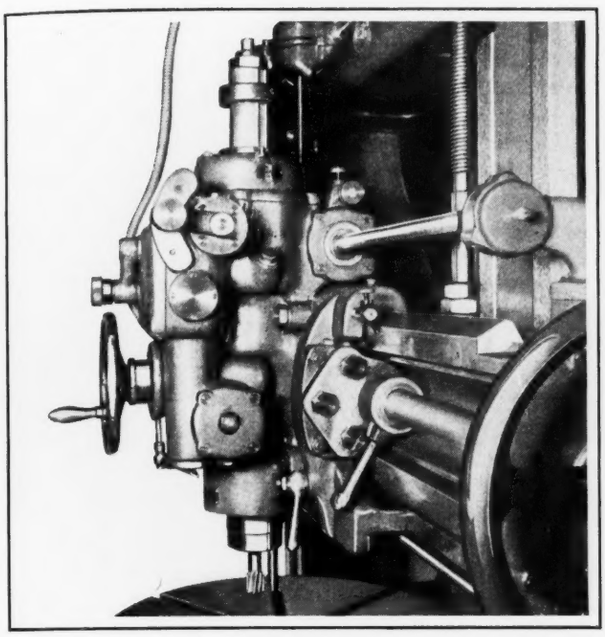


Fig. 3. Close-up View of Boring Head from Right-hand Side

three indexing disks by means of which any number of holes from 2 to 100 can be laid out around a circle without calculating for the successive settings. These index-plates can be attached without removing the micrometer head, and a special device enables the micrometer head to be used for special settings while the index-plate is in place.

A releasing clutch on the handwheel used for moving the table avoids accidental movement after a setting has been made. On the MP5B machine, there is now a handwheel conveniently low for the operator, which is connected by a shaft and gears to the horizontal shaft that is turned to rotate the nuts on the vertical raising screws. Covers for the projecting vertical screws are now a permanent feature. The location of the compensating templet for the transverse micrometer screw is such as to protect it better than on previous models, as illustrated in Fig. 3. The lever system of transmitting corrections to the screw from the templet to the vernier index has been discarded in favor of the rotating rod previously used for the same purpose with the rectangular table.

There is an improved prismatic microscope, consisting of a 45-degree prism for the reflection of illumination from a light source to the work. The reference square used with the microscope for making settings to the edge of a job is now chromium-plated. Another new accessory is a vertical indicator device for checking the parallelism of a workpiece with the table, measuring the depth of counterbores, or checking two surfaces at different heights to insure that they are both parallel with the table. This indicator can also be used for a variety of other measurements. Another measuring feature is a micrometer drum on the hand-feed shaft of both spindles by means of which the exact depth of blind holes or counterbores can be measured.

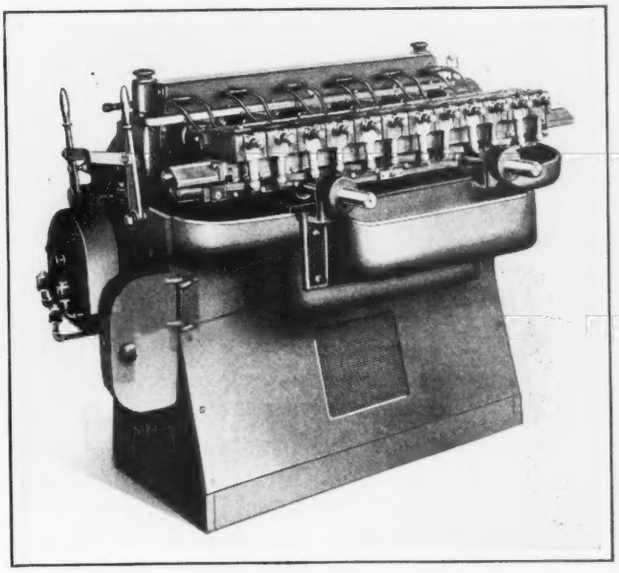
A pump and piping for the coolant system, heretofore regularly incorporated in the machines, are now furnished only when ordered, and a belt tightener is also supplied as an extra. A series of long-style end-mills is available for both the old and the new jig boring machines. These tools have a greater length below the shank than formerly so as to enable deeper holes to be bored. Straight-shank end-mills are also available in the smaller sizes, and Jacobs chucks with arbors to fit the spindles may be supplied for holding center drills, countersinks, and similar tools.

KENT HORIZONTAL MULTIPLE-SPINDLE DRILLING MACHINE

The Kent Machine Co., Cuyahoga Falls, Ohio, has recently brought out a multiple-spindle drilling machine similar in design and operation to the standard No. 1 six-spindle machine described in January, 1926, MACHINERY, page 412. The new machine, however, in addition to drilling several pieces during one cycle, can be adapted for drilling several holes in each piece by using cluster drill heads. The machine is built with six single spindles at 7 1/2-inch center distances or with a series of six cluster drill heads the same distances apart.

Fixtures may be designed to accommodate any work within the capacity of the machine. Twelve fixtures are required, two for each drill head, as the fixtures alternately occupy positions in front of and between the drill heads. When in line with the heads, the fixtures are automatically locked, so as to hold the work securely for the operation, while in the alternate positions the fixtures are open to allow the operator to remove the previously drilled parts and reload for the next operation.

Either a motor or belt drive is furnished. When a motor drive is employed, the motor is mounted on a movable angle-plate in the base, and can be



Kent Multiple-spindle Machine which can be Arranged with Cluster Drill Heads

quickly adjusted for changes in speed or for tightening the silent chain.

Production is governed by the rotation of the camshaft, which is controlled through a series of change-gears and adjustable dogs. By means of this combination it is possible to synchronize the speed of production with the ability of the operator to load the work fixtures. The feed of the drills can be varied by means of the change-gears that control the camshaft.

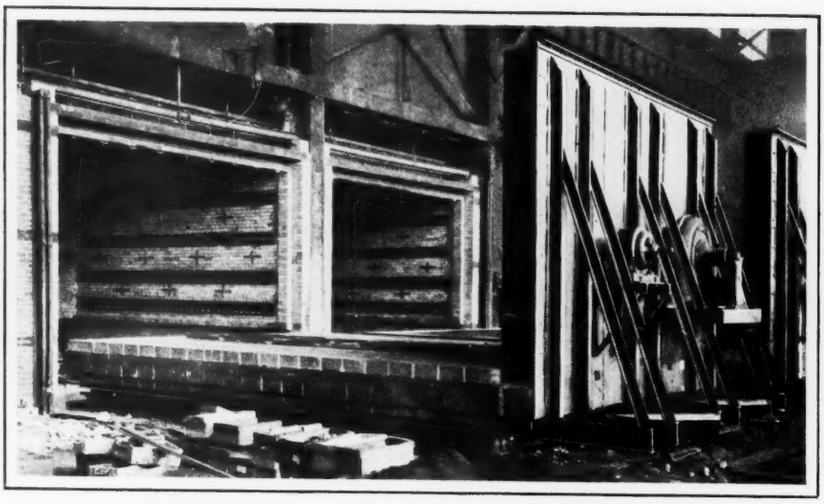


Fig. 1. General Electric Furnace which may be Operated at Variable Heating and Cooling Cycles

GENERAL ELECTRIC FURNACES

An electric furnace intended for annealing alloy steels, which has been designed to give variable heating and cooling cycles, has recently been brought out by the General Electric Co., Schenectady, N. Y. The heating units of this furnace, which is shown in Fig. 1, are so distributed that "hot spots" are avoided and uniform heating results. The furnace walls are insulated in the same manner as furnaces that are operated continuously at higher temperatures, and the furnace is lined with light-weight refractories of low thermal capacity. It is possible for the furnace walls to heat or cool very quickly thus giving flexibility to the heating and cooling cycles and increasing the furnace economy.

Variation of the cooling period is possible through the use of cooling coils and a ventilating system that can be sealed tight by insulated doors during the heating period. The rate of cooling is varied by altering the amount of air blown through the ventilating system. None of the cooling air enters the furnace chamber. After the work is cooled by the coils to below the critical temperature, the covers may be opened and the cooling further accelerated by a flow of air into the bottom vents, through the furnace and out through the top vents.

Fig. 2 shows another electric furnace brought out by the General Electric Co. This is of the mesh-belt conveyor type and has an automatic feed and discharge. This furnace is of rectangular form, being about 8 feet long, 4 feet wide, and 4 1/2 feet high, over-all. A small heat-insulated housing is provided for the feed end of the belt to prevent unnecessary heat losses.

The mesh-belt conveyor, being made of a heat-resisting alloy, is the principal feature of the furnace. The belt is carried over two drums, also made of a heat-resisting alloy, one of which is driven by a motor through a gear reduction and speed transmission. The driving mechanism is so designed that slack is automatically taken up when the belt is hot. This furnace will handle up to 300 pounds of work per hour in shapes up to 16 by 2 1/2 inches, over-all.

The same concern has also just brought out an electric furnace especially designed for heat-treating aluminum alloys. This furnace is a pit-type cylindrical unit having two circuits, one of which is in the top and the other in the lower side walls and bottom. In a typical design, the diameter is 4 feet and the depth, 6 feet. This size furnace was built to heat a charge weighing 1500 pounds, plus a basket weight of 500 pounds, from 600 to 950 degrees F. in one hour and to hold the charge at this temperature for twelve hours.

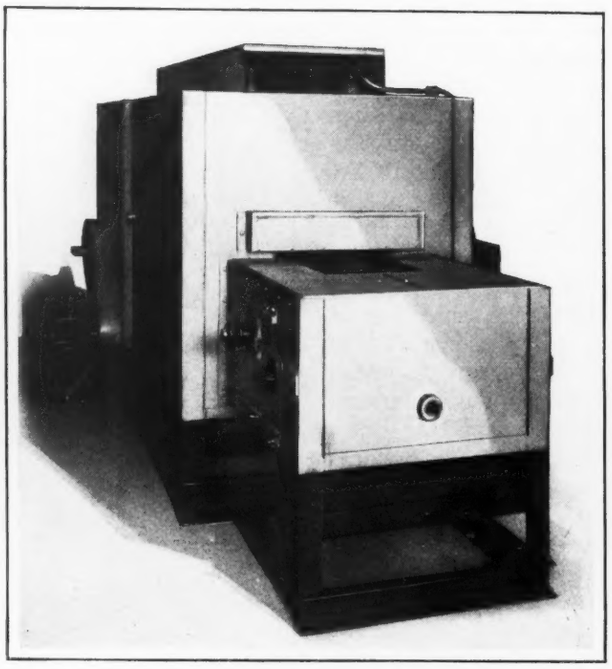
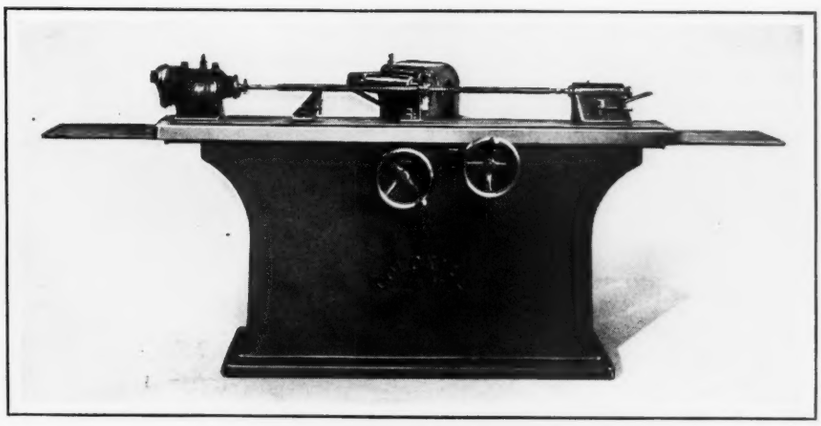


Fig. 2. Furnace with Mesh-belt Conveyor for Feeding and Discharging Automatically

COLONIAL BROACH SHARPENER

A machine designed exclusively for sharpening broaches is being introduced on the market by the Colonial Tool Co., Inc., 8432-8510 Butler Ave., Detroit, Mich. From the illustration it will be seen that this equipment is of simple design. The

broaches are held between centers, as shown, and driven from the headstock end by a motor of 1/3-horsepower capacity which runs at 1140 revolutions per minute. Three headstock spindle speeds ranging from 200 to 600 revolutions per minute are available.



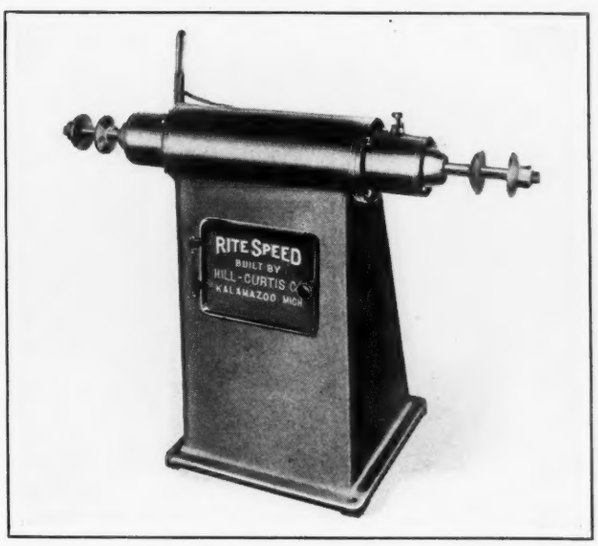
Colonial Broach Sharpening Machine

The grinding-wheel spindle is driven by a 3/4-horsepower motor running at 1800 revolutions per minute, which is connected to the wheel-spindle by belt. A feature of the grinding head is provision for swiveling it to any angle up to 45 degrees to suit the rake angle of the broach teeth being sharpened. Either a 5-inch saucer or straight wheel can be employed.

Rapid sharpening of broaches is one of the principal advantages claimed for the machine, as well as economical operation. It is stated that resharpened tools will produce as many broached parts after each sharpening as when the broaches were new. The maximum distance between the centers of the machine is 60 inches, and the centers swing broaches up to 10 inches in diameter. The operating floor space occupied is 15 by 3 feet, including the space required for the table travel.

"RITE SPEED" MOTOR-IN-BASE POLISHING AND BUFFING LATHE

A polishing and buffing lathe driven by a motor enclosed in the base has been added to the line of "Rite Speed" equipment built by the Hill-Curtis Co., Kalamazoo, Mich. In addition to the style illustrated, this machine can also be furnished with the overhanging type of spindle. Power is transmitted from the motor to the spindle by means of multiple V-type belts, and it is therefore possible to furnish this machine for running at any desired speed. Adjustments for taking up slack in the belts can be made from the outside of the machine without disturbing the motor mounting. An automatic starter with overload protection is standard equipment.



"Rite Speed" Motor-in-base Polishing and Buffing Lathe

A new feature which is now provided on all "Rite Speed" polishing machines is a combination switch and brake, with which arrangement it is only necessary for the operator to pull the lever forward in order to break the current connection and apply the brake. By reversing this movement of the lever, the brake is released and the motor started.

As with other polishing and buffing lathes built by this concern, the belts can be easily changed. Four large cap-screws on each side of the spindle are removed, after which the entire spindle unit can be taken from the pedestal without disturbing the bearing mounting. The motor adjustment screw is next loosened to take the tension off the motor pulley, and then the belts are slipped from the spindle. Timken tapered roller bearings or ball bearings, as preferred, are provided.

THOMSON VERTICAL AND SEAM WELDING MACHINES

A heavy-duty power-driven vertical welder recently developed by the Thomson Electric Welding Co., Lynn, Mass., is illustrated in Fig. 1. Practically all frame parts of this model 290 machine, with the exception of the lower slide, upper terminal block, and the upper slide, are made of heavy plate and bar stock fabricated by electric arc welding. The fabricated units are bolted or welded together. This machine has a transformer rated at 350 kilovolt amperes.

Conventional methods of operating automatic spot welders are followed in this machine; that is, the movement of the upper slide is obtained through a heavy rocking arm or lever that is actuated by a cam. The camshaft is driven by a 4 1/2-horsepower four-speed motor having a push-button control. The motor drives through a reduction gear to the cam, which has a removable insert. This insert furnishes the final pressure on the weld and can be varied to suit condi-

tions. Any desired operating position may be arranged by simply wiring to the point where the operator wishes to stand.

A dual pressure arrangement has been built into this machine consisting of three springs, two light springs being set into the upper slide head with a heavy spring between them. The machine is so adjusted that the light springs apply pressure at the time that the current is turned on and the heavy spring engages as the weld is finished in the form of a positive bump or blow. The amount of this blow can be varied through an adjustment provided for the heavy spring, and the initial pressure can also be varied by adjusting the lighter springs. The particular advantage mentioned for this dual pressure arrangement is that it permits low welding currents. The lower knee of the welder is adjustable vertically to compensate for die wear and to suit work of different thicknesses.

This machine was designed for a wide variety of work, such as light fabricated joists and similar structural shapes, as well as for multiple projection welding on medium or heavy stampings, forgings, etc. It may be adapted for butt welding parts which can best be handled in a vertical type of machine. The approximate weight is 10,000 pounds.

Fig. 2 shows a model 375 heavy-duty double-roller seam welder which has also been brought out by the company. This machine has a throat depth of 30 inches and may be supplied with a transformer rated at 100, 150, or 175 kilovolt amperes.

One of the principal features of this equipment is the mounting of the upper roller, which is of the offset or open-side type which can be quickly replaced. The roller is a copper forging, and is mounted on the large hub of a shaft made of a special long-life material. This shaft, as well as the shaft-bearing housing, is water-cooled. The construction of the bearing housing and its mounting is such that they can be rotated through 90 degrees without disconnecting or breaking any electrical joint. This rotating feature permits the welder to be used for either longitudinal or circumferential seam welds by merely interchanging lower horns. The same simplicity of roller mounting is used for the lower horn, and this horn, as well as the roller shaft, is water-cooled. The revolving speed of the upper roller can be altered through change-gears.

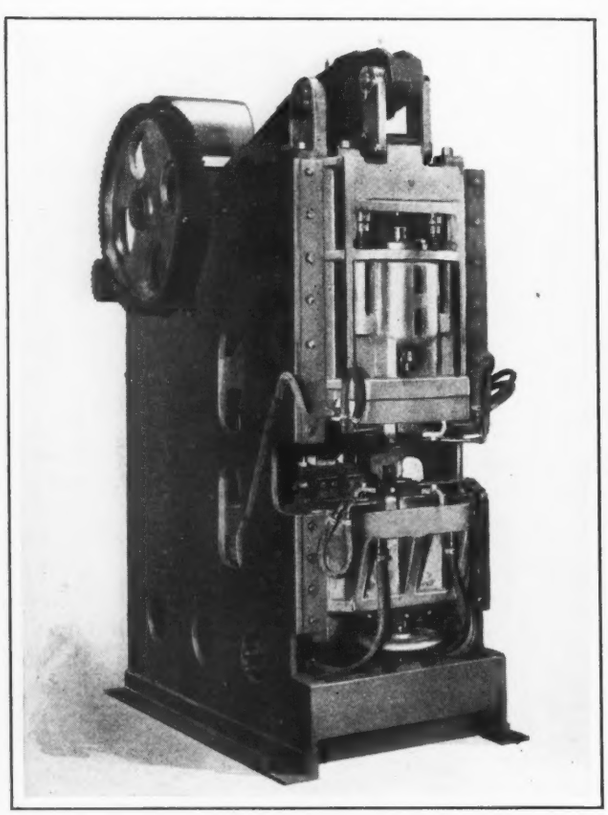


Fig 1. Thomson Vertical Welder with Dual Pressure Arrangement

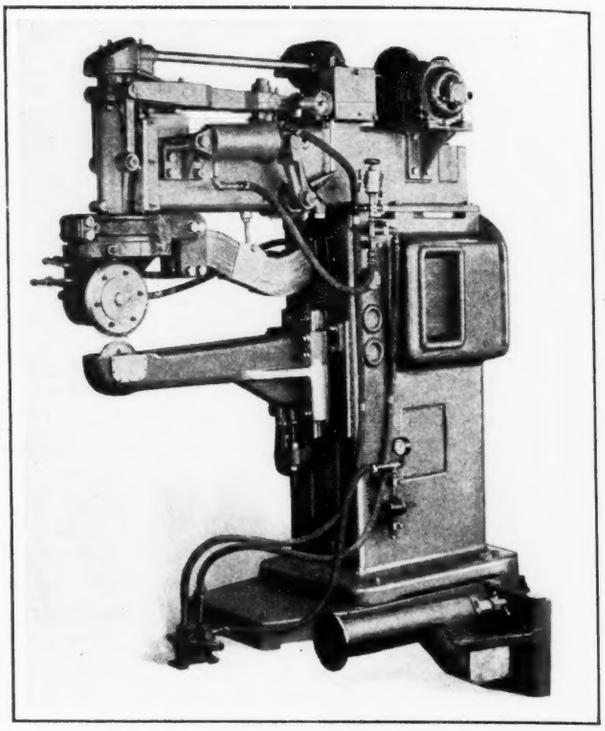


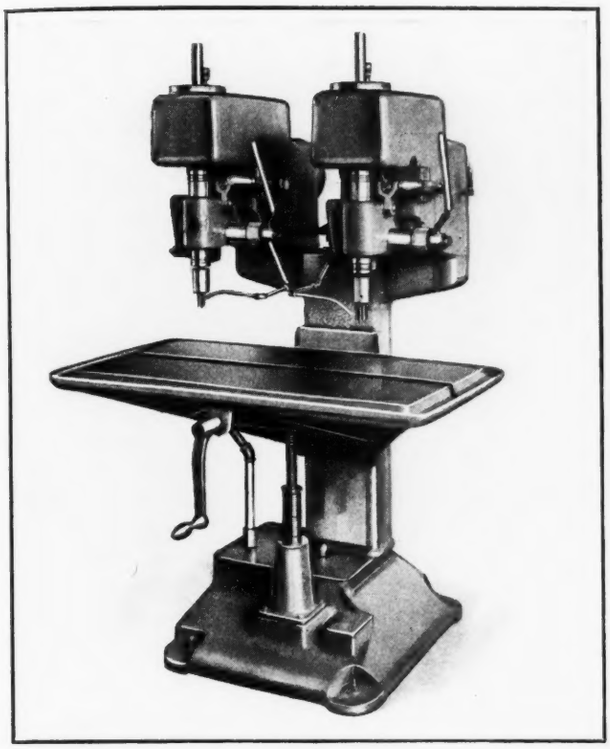
Fig. 2. Double-roller Seam Welder with Improved Means of Mounting and Cooling the Electrodes

Pressure on the work or the electrodes is obtained by means of an air cylinder which operates through an adjustable pressure spring. The initial air-line pressure to the cylinder can be varied through an adjustable relief valve, the pressure cylinder being controlled by means of a foot valve. The welding current is automatically turned on and off by the pressure cylinder.

This machine is intended for use on flat or cylindrical steel or iron stock up to No. 14 gage.

RICKERT-SHAFER SEMI-AUTOMATIC TAPPING MACHINE

A friction-driven geared semi-automatic tapping machine which is made in a single-spindle style or with a multiple number of spindles is a recent development of the Rickert-Shafer Co., Erie, Pa. A machine equipped with two spindles is shown



Rickert-Shafer Friction-driven, Geared, Semi-automatic Tapping Machine

in the illustration. One of the principal features of this tapping machine is the use of a multiple-disk friction clutch for driving the spindles, thereby eliminating tap breakage.

For production on an automatic basis, a block is set to give the desired depth of feed. This block is located on a serrated cam on the left-hand side of the spindle housing. Pulling downward on the handle engages the friction clutch and causes the tap to be driven into the work. When the required depth is reached, the block trips the mechanism, releasing the clutch in one direction. The clutch is then immediately thrown into engagement in the reverse direction, setting in operation a train of gears which reverse the rotation of the spindle and back the tap out of the work. A slight upward thrust on the handle then reverses the mechanism, ready for the next piece. In ordinary friction tapping, one operator can keep two spindles going full time.

The machine is furnished with a pump and equipment for supplying coolant or oil to the taps at all times. The overflow is returned to a reservoir in the base. Either a belt or motor drive can be supplied. Threads up to 1-inch United States standard, eight per inch, have been tapped in tests without the machine showing any indication of being overloaded.

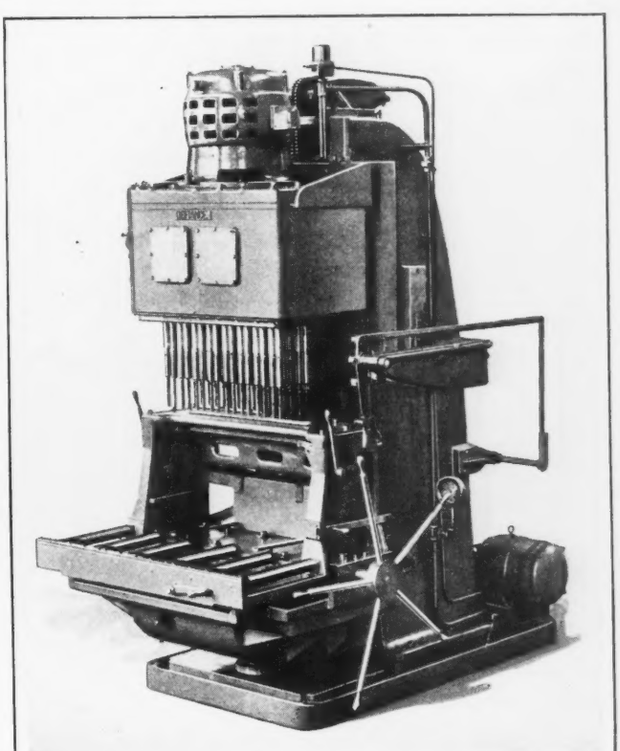
DEFIANCE MULTIPLE-SPINDLE MACHINE WITH OILGEAR FEED

A fixed-center multiple-spindle machine designed for drilling, reaming, counterboring, and spotfacing valve holes in automobile and tractor cylinder blocks and heads is the latest development of the Defiance Machine Works, Defiance, Ohio. The fixed-center head can be made with any number of spindles to suit requirements. A direct-connected motor mounted on the head, as illustrated, drives the spindles. A motor of from 15 to 20 horsepower capacity, running at a speed of 1200 revolutions per minute, is recommended for this purpose. The spindles are equipped with heat-treated gears of the helical type wherever possible, and with ball thrust bearings. The head is completely enclosed, and is lubricated by means of a force-feed system.

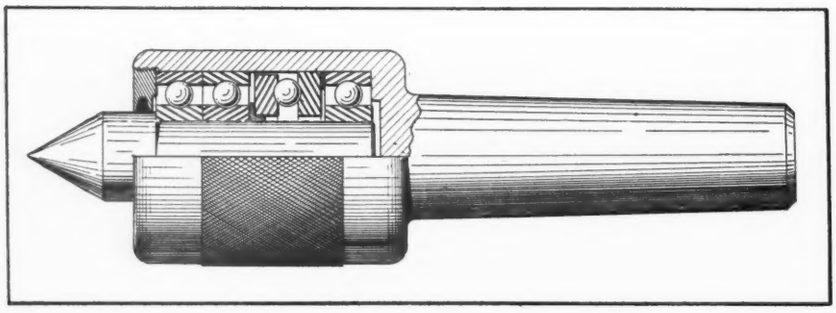
The machine is provided with an Oilgear feed which can be adjusted to suit requirements and gives rapid traverse movements to and from the work. A motor of 2 horsepower capacity, running at a speed of 900 revolutions per minute, drives the Oilgear unit.

The table extends a considerable distance in front of the machine and is fitted with rollers to match conveyor tables, so that cylinder blocks can be easily passed from one machine to the next. The table is adjustable and a screw jack supports the overhanging part. The column is a heavy casting, supporting the Oilgear cylinder that operates the head and enclosing weights that counterbalance the head.

Fixtures can be built to suit various operations. In some instances, the fixtures are of a rigid style, while for other operations sliding type fixtures with bushing plates and hardened jig eyes are furnished. The machine occupies a floor space of 108 by 64 inches, and has a net weight of 18,500 pounds.



Defiance Multiple-spindle Machine Designed for Various Operations on Cylinder Blocks and Heads



"Alive" Ball-bearing Tailstock Center

"ALIVE" BALL-BEARING CENTERS

Live ball-bearing tailstock centers of an improved design are being placed on the market by the Modern Machine Corporation, 285-287 N. 6th St., Brooklyn, N. Y., in heavy- and light-duty styles and in a complete range of sizes. In the heavy-duty style, here illustrated, the center point revolves in three radial-type ball bearings and the thrust load is carried by a ball thrust bearing located between two of the radial bearings. The light-duty style follows the same design, except that there are only two radial ball bearings.

The center point is made of tool steel, hardened and ground, while the shank, together with the integral housing, is made of a high-carbon steel. The shank is ground to insure concentricity with the revolving center point. As the center point revolves with the work, it does not receive wear, and so regrinding is never necessary.

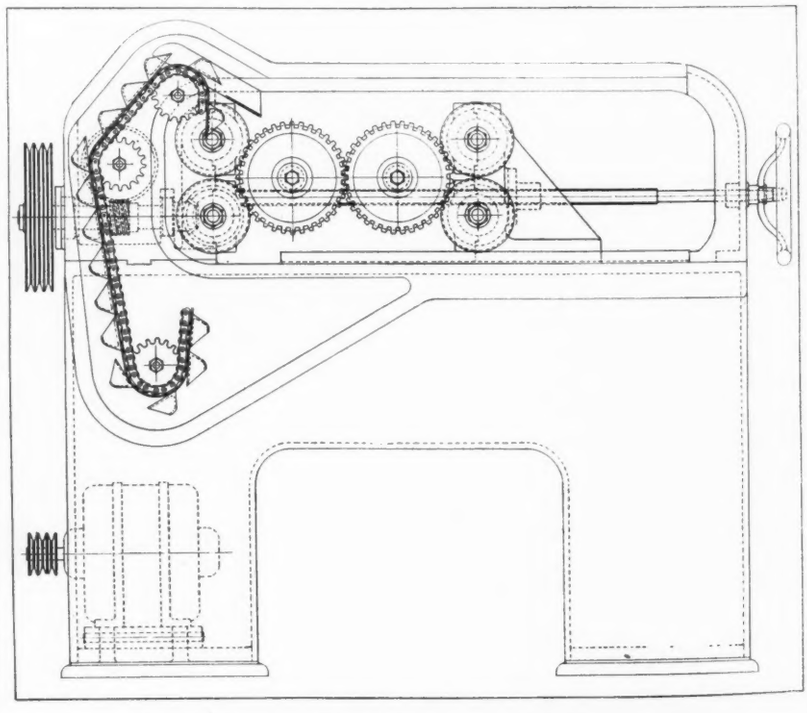
The various sizes of the heavy-duty style have center points from 7/8 to 2 1/8 inches in diameter, while the center points of the light-duty style range from 1/2 to 1 inch in diameter.

LEHMANN GEAR LAPPING MACHINE

A perfect gear, viewed from the standpoint of smooth running qualities, would be exemplified by a perfectly round disk rotating in peripheral contact with another perfectly round disk. The lack of traction with reasonable bearing pressure renders teeth necessary, but it is difficult to maintain the same smoothness of operation with teeth. A machine designed for lapping the teeth of gears, especially hardened gears, to the shape necessary for smooth running has been developed by the Lehmann Machine Co., 3571 Chouteau Ave., St. Louis, Mo. The functions of this machine are based on corrective abrasion governed by the restraining movements of round disks under pressure contact.

This machine, which will be shown at the National Machine Tool Builders' Exposition to be held in Cleveland, Ohio, from September 30 to October 4, inclusive, consists primarily of two spindles, on the outer ends of which are secured the mating gears to be lapped. These spindles carry hardened friction rolls of the pitch diameter of the gears being lapped, and are driven by contact with rolls on the driving spindles of the machine. Two of these driving spindles are journaled in a head which can be adjusted to bring the gear-carrying spindles together until their hardened rolls are under pressure contact, and the position of the mating gears is limited to the correct center distance. The pressure on the disks, necessary for the desired effect, reacts on eight large ball bearings in which the friction rolls are journaled. While the gears govern the general relative movement, the disks resist any departure from the regularity of their normal movement. Oil and abrasive are fed to the gears being lapped.

Absolute exactness in the diameter of the disks is always lacking to a sufficient degree to cause a slight departure from their correct relative general movements. This difference results in a continuous pressure on one side of the gear teeth, at first effective only on such irregularities as project beyond the correct tooth curves. As the abrasion is continued, the irregularities become less and less pronounced until the desired smoothness of action is developed. A reversal in the direction of rotation brings the other sides of the teeth in contact, with the same results. No change in pitch diameter occurs, as the corrective abrasion only thins the teeth to the extent of the projecting irregularities.



Lehmann Gear Lapping Machine Shown Diagrammatically

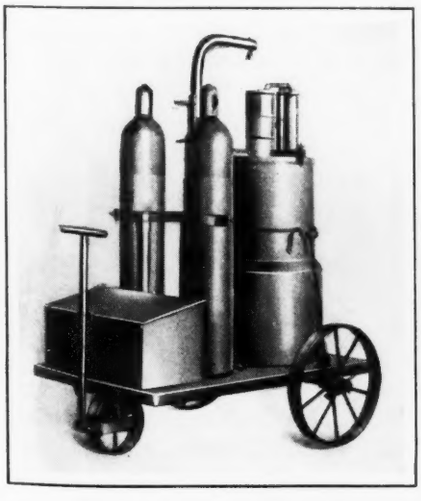
Gears with hunting teeth more readily and effectively compromise with the restraining movement of the disks because of the greater distribution of transferred error. When gears have numbers of teeth with common multiples, any considerable error in tooth form would necessitate several different meshings of the gears for proper results.

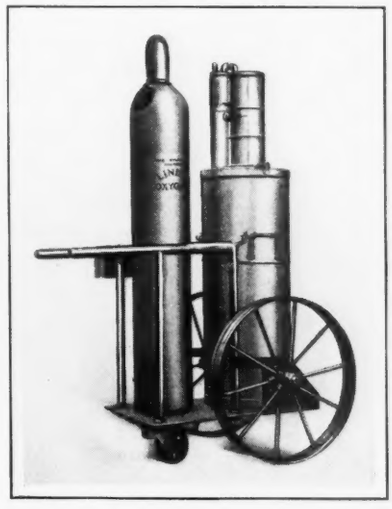
A few minutes of running usually suffices to obtain the desired smoothness of action between the gears. They are quickly put on the machine and removed, and one operator can take care of several machines. When a large quantity of gears of a given size is to be lapped, the principle of the machine can be adapted to a simpler form of design.

TRUCKS FOR "CARBIC" GENERATORS

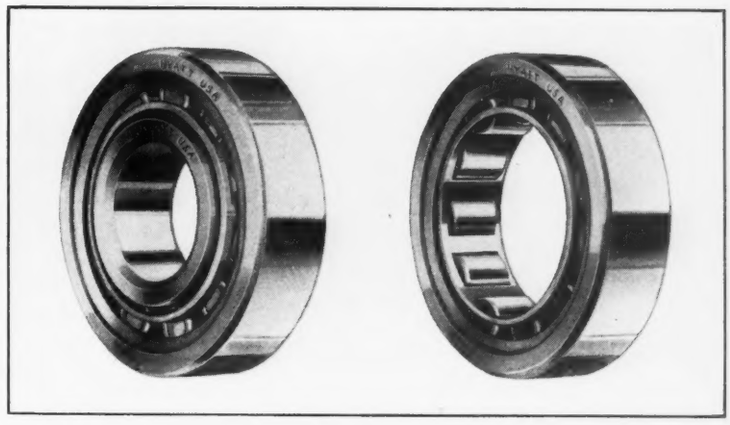
Two trucks designed to accommodate the types CLP-3 and CLP-2 "Carbic" low-pressure acetylene generators have been brought out by the Oxweld Acetylene Co., 30 E. 42nd St., New York City. These trucks are shown in Figs. 1 and 2, respectively. The first mentioned truck accommodates two cylinders of oxygen in addition to the generator. Two 24-inch steel wheels, with tires 3 inches wide, carry the back part of the truck, while a third wheel at the front, of the caster type, allows the truck to be turned in a radius approximately equal to its own length. This caster wheel is 12 inches in diameter.

The generator is secured to the steel deck of the truck by means of angle-iron braces and two long bolts which are inserted in the handles of the generator and tightened by means of turnbuckles. A crane is provided for use in charging and emptying the generator. The smaller truck, shown in Fig. 2, accommodates one cylinder of oxygen in addition to the generator. It also has two 24-inch steel wheels at the back and a 5-inch caster wheel at the front.





Figs. 1 and 2. Trucks Designed to Carry Acetylene Generators and Oxygen Cylinders



Hyatt Solid-roller Bearing with and without the Inner Race

HYATT SOLID-ROLLER BEARINGS

Single-row radial bearings made up of solid rollers are being introduced to the trade by the Hyatt Roller Bearing Co., Newark, N. J., to interchange with standard S A E single-row ball bearings. These solid roller bearings are not intended to replace the standard Hyatt bearing which uses spirally wound rollers, but are offered as a supplement to it for cases in which space limitations exist and loads beyond the capacity of ball bearings must be sustained. The new bearings are made in a range of sizes.

In the new design, the rollers are permanently retained in the outer race, the inner race being separable, as may be observed from the right-hand view of the illustration, which shows a bearing from which the inner race has been taken. A separator that floats on the rollers spaces them properly, and heat-treated rings retain them endwise within the outer race. The end rings and separator keep the rollers in proper alignment and insure positive contact for their full length.

The rollers and races are made of chrome-nickel steel, and the end rings of vanadium steel. The bore, outside diameter, and width of the bearings correspond to the metric dimensions of standard S A E ball bearings. The roller ends are rounded to facilitate assembly in installations where the inner race is not used, and both the outer and inner races are chamfered at one end.

AMERICAN FLEXIBLE COUPLING

Complete flexibility without the use of flexible materials is the principal feature claimed for a coupling now being placed on the market by the American Flexible Coupling Co., Erie, Pa. This coupling is designed to compensate for misalignment of direct-connected shafts, whether angularly or laterally out of

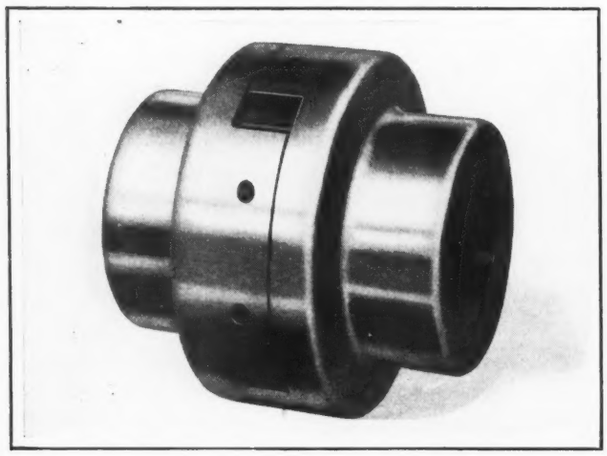


Fig. 1. Flexible Coupling Designed to Compensate for Angular and Lateral Misalignment of Shafts

alignment. The device is of simple construction, as may be seen from Fig. 2, there being only three main parts. Two of these parts are identical flanges, while the third is a square center floating member. Flexibility is obtained by the square center member being full floating across the face of one flange on a line passing through the center, and also being free to slide across the face of the second flange in a direction at right angles to the first.

Another feature of the coupling is the self-lubricating provision. The square center part is a hollow casting which is filled with grease. Four small holes in each bearing surface of the part are provided with porous wood reeds which lead from the grease to felt pads in replaceable bearing strips. When the coupling revolves, centrifugal force causes the grease to ooze slowly through the pores of the wood reeds to the felt pads.

It is only necessary to refill the grease compartments about once every year, and this can be done quickly by removing any one of the bearing strip screws and applying a grease gun. The bearing strips are made from a tough non-metallic compound which has good wearing qualities and resists the action of heat, moisture, and dirt.

The coupling can be furnished in various sizes for shafts from 1/16 to 22 inches in diameter, and for all classes of service. Fifteen sizes, for shafts from 3/4 to 8 inches diameter, are carried in stock.

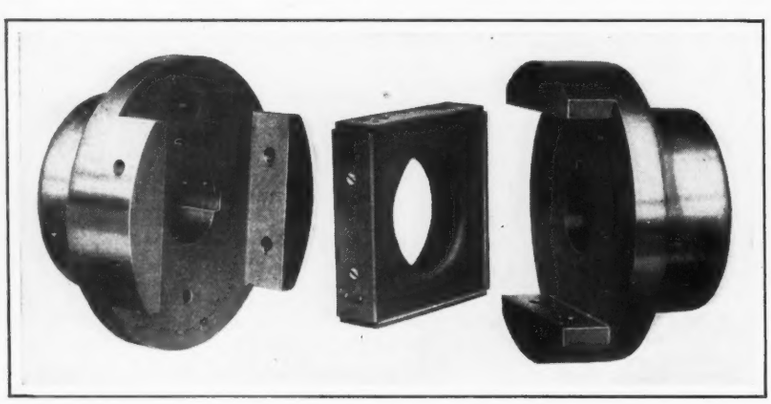


Fig. 2. Details of New Coupling Made by American Flexible Coupling Co.

GARVIN SPEED-BOX WITH TIMKEN BEARINGS

A three-change speed-box equipped complete with Timken tapered roller bearings has been brought out by the Western Machine Tool Works, Holland, Mich., for application to the Garvin No. 1 automatic tapping machine built by the same concern. The illustration shows one of these machines provided with a speed-box that is direct-connected to a driving motor, but a single pulley drive can also be furnished. The motor speed is 1200 revolutions per minute, and in a single-pulley drive, the input speed is 1150 revolutions per minute. By means of the speed-box, speeds of 300, 400, and 600 revolutions per minute are available with a 12-inch driven

Garvin Tapper with Speed-box Having Timken Bearings

pulley, and speeds of 450, 600, and 900 revolutions per minute, with an 8-inch driven pulley.

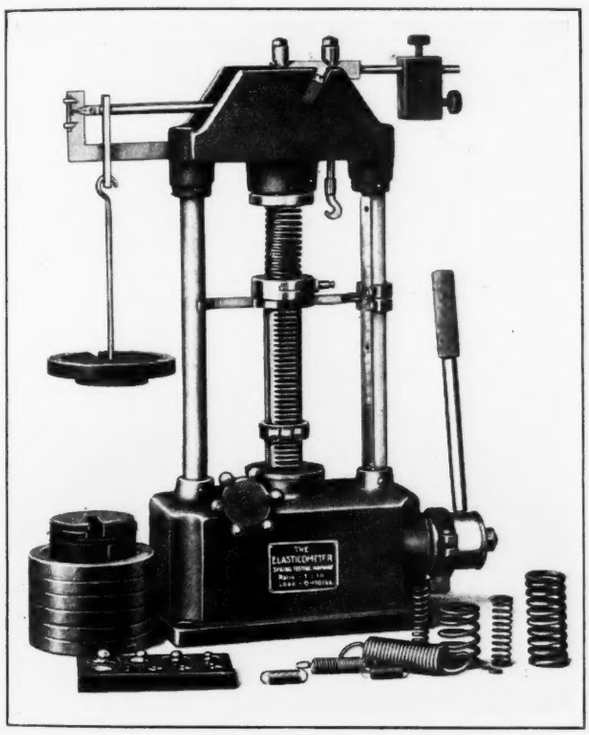
The gears of the speed-box are made of chrome-nickel steel and heat-treated. The sliding cone gear has a long bearing on the shaft, which prevents chattering and permits easy shifting. All shafts are ground and provided with finely threaded nuts for close adjustment of the Timken bearings. Adjustments can be made from the outside of the box. All parts in the box are lubricated by running in a bath of oil.

"ELASTICOMETER" SPRING TESTING MACHINE

The type R-80 "Elasticometer" spring testing machine here illustrated is being introduced on the

market by the Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City, to replace the RH-80 model described in June, 1927, MACHINERY, page 799. The new instrument differs entirely from the previous one in that it is of the pillar type. The principal improvement, however, is the reduced number of knife-edges, which has greatly increased the sensitiveness of the weigher scale. There are now only two levers, and the weigher scale can be completely assembled in a few minutes.

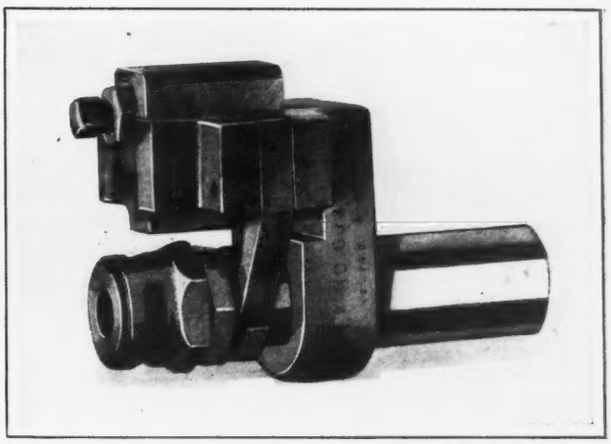
The knife-edges now consist of one piece of hardened tool steel, instead of being assembled in cast-iron levers, and are ground in position on the machine. Periodic inspection of the knife-edges for the purpose of cleaning can be easily accomplished.



Elasticometer for Tension and Compression Tests on Springs

The ratio of the scale is again 1 to 10, but the actual length of springs in either the compressed or elongated states is now shown by a scale on the right-hand pillar. A weight with a fine adjusting screw, which may be seen in the extreme upper right-hand corner of the machine, is used for balancing the equipment before using it. There is an adjustable stop at the left of the hand-lever which may be set for any given length of compression or tension to permit the rapid inspection of large quantities of duplicate springs.

This machine is designed for loads from 1/4 ounce to 170 pounds. The maximum distance between compression plates or tension hooks is 8 inches, and the maximum spring diameter that can be accommodated is 2 3/8 inches. The machine has an approximate weight of 70 pounds.



Acorn-die Holder Intended for Brown & Sharpe Automatic Screw Machines

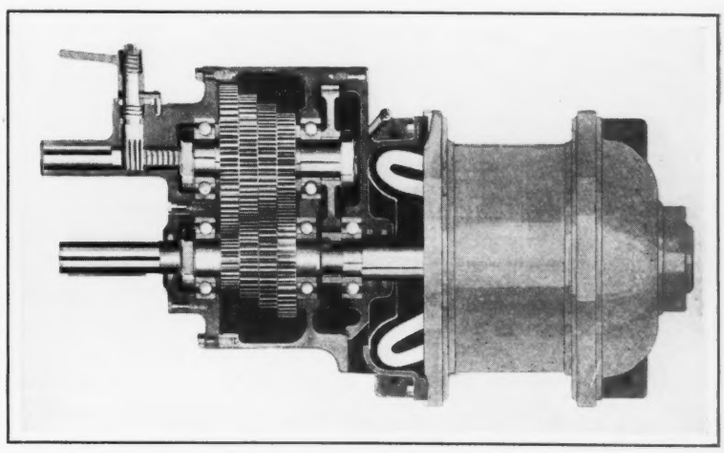
BROWN & SHARPE RELEASING DIE-HOLDER

A releasing die-holder has recently been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., for use with acorn dies on B & S automatic screw machines. This holder is particularly advantageous when it is desirable to hold threads to a definite length, as in threading close to a shoulder. An adjustable screw on the front of the holder comes in contact with the chuck guard over the machine spindle, thus governing the length of thread. This releasing die-holder is intended for use on the Nos. 00 and 00G machines.

WISE MULTI-SPEED TRANSMISSIONS FOR MACHINE TOOLS

Multiple-speed transmissions designed primarily for application to machine tools have been placed on the market by the Wise Mfg. Co., Eighth and Carlton Sts., Berkeley, Cal., in sizes of from 1/2 to 10 horsepower. These transmissions are built to replace the end bracket of electric motors of any make, and deliver four speeds in geometric ratio. Speeds up to 25 per cent above the motor speed and as low as 280 revolutions per minute are obtainable.

A feature of the transmission is that speeds can be selected while the tool or machine being driven



Wise Multi-speed Transmission Intended for Application to Machine Tools

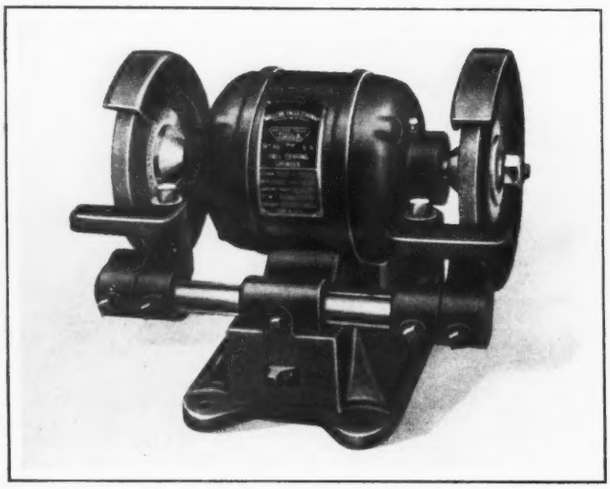
is in operation. Thus, in cases where large diameters are being turned, speeds can be changed as the tool approaches the center of the work, without removing the tool from the cut. The motor can be reversed electrically to give four speeds in reverse. Speed changes are made through a lever which can be placed in the most convenient position for the operator. There is a neutral position between each speed, so that the operator can stop the drive shaft of the machine without stopping the motor.

The unit consists of a casing within which the motor shaft projects. The shaft that drives the machine is in axial alignment with the motor shaft. The latter carries a pinion gear that is constantly in mesh with a gear on the countershaft. Gears are keyed to the drive shaft, while the jack-shaft gears have internal clutches that are actuated by means of a mechanism. With this arrangement, the operator can instantly select any desired speed. The clutches are self-adjusting. Both the drive shaft and the countershaft are mounted in ball bearings.

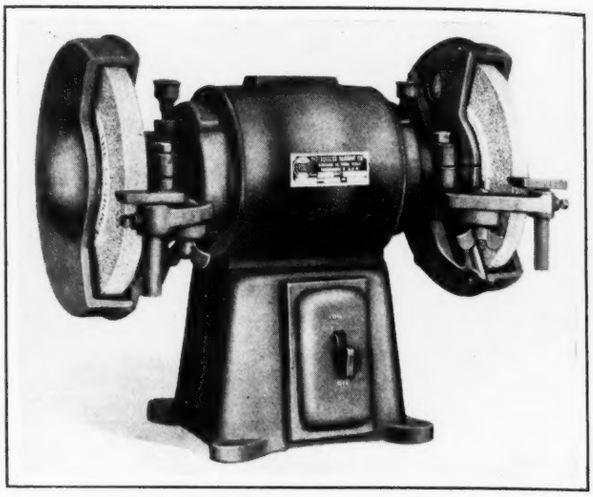
MILLERS FALLS MOTOR-DRIVEN BENCH GRINDER

A 6-inch electrical bench grinder is now being placed on the market by the Millers Falls Co., Millers Falls, Mass., primarily for use in shops and small departments where a machine of this type is required only occasionally. The equipment is driven by a totally enclosed motor of 1/4 horsepower capacity. With direct current or 60-cycle alternating current, the motor speed is 3500 revolutions per minute, and with 25-cycle alternating current, the speed is 1450 revolutions per minute.

Ball bearings are provided to give smooth operation and long life. There are two adjustable guards and two adjustable tool-rests. The grinder has an over-all width of 12 3/4 inches and an over-all height of 9 1/2 inches. The weight is approximately 40 pounds. The wheels are 6 inches in diameter by 1/2 inch wide and have 1/2-inch holes.



Millers Falls Small-size Bench Grinder



Schauer One-horsepower Bench Grinder

SCHAUER BENCH GRINDER

A one-horsepower bench grinder recently added to the "Ideal" line of products made by the Schauer Machine Co., 905-907 Broadway, Cincinnati, Ohio, is shown in the accompanying illustration. This type D2B grinder is designed for use with either alternating or direct current. It is mounted on an improved base which contains a safety-type toggle switch for quick making and breaking of the electrical contact.

The motor is totally enclosed to permit the use of the equipment for either wet or dry grinding. The wheels are enclosed by end guards of a new design on which tool-rests are so mounted as to be readily adjustable into the desired positions. The end bells are designed to give maximum working space between the motor housing and the wheels. Solid-race double-row ball bearings are provided, one at each end of the shaft. They operate in grease and are dustproof.

The distance from the base of the grinder to the center of the wheels is 11 inches, and 10- by 1-inch wheels are used. When the machine is operated on direct current, the wheels run at 2000 revolutions per minute, and when alternating current is used, the wheel speed is 1750 revolutions per minute. The weight of the equipment is approximately 160 pounds.

LINCOLN "NEW KATHODE" WELDING ELECTRODE

A welding electrode known by the trade name of "New Kathode" is being introduced to the trade by the Lincoln Electric Co., Cleveland, Ohio. This electrode is intended for use in arc-welding mild steel and cast-iron repair work. The advantages claimed are an easy flow free from sputtering, the production of clean welds with minimum slag and oxidation, and permissible high heat which, together with the fast running character of the electrode, makes possible increased speed of welding. Welds on steel are soft and readily machineable.

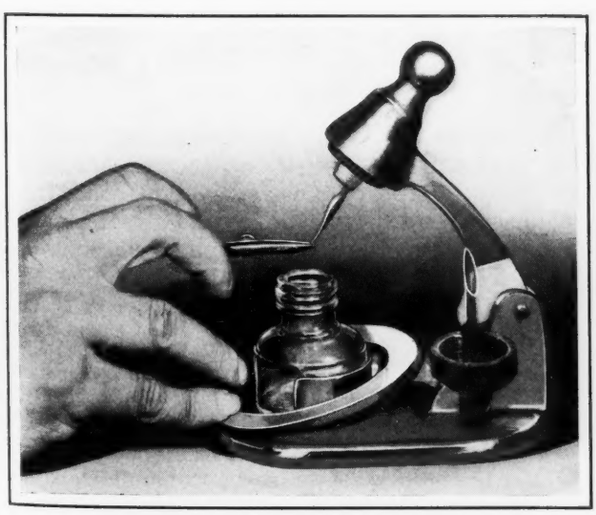
This electrode is manufactured in stock lengths of 14 and 24 inches. To provide protection during shipment, it is packed in metal containers holding 50 pounds each.

DRAFTSMAN'S PEN-FILLING INKSTAND

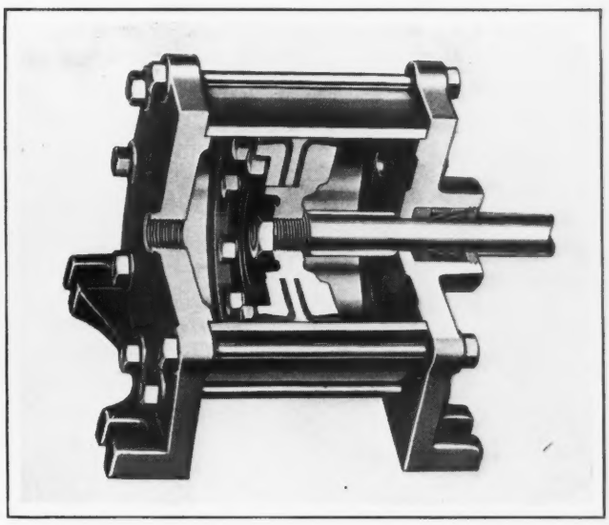
A draftsman's pen-filling inkstand designed to hold regular 3/4-ounce ink bottles is now manufactured by the National Tool Engineering Co., P. O. Box 712, Indianapolis, Ind., in addition to the inkstand with an integral cast bowl which was described in November, 1926, MACHINERY, page 232. In the new stand, the ink bottle is held in place by means of a tempered steel spring clip which fits around the body of the bottle. With this construction, the same stand can be used for different colored inks by simply changing the bottle and the filler pen. The latter is fitted into a standard holder and can be easily changed.

In filling a ruling pen, the draftsman pushes the ring of the stand downward with his little finger, as illustrated, thus lifting the top which holds the filler pen, and then he immediately applies the ruling pen to the filler pen. When his little finger is removed from the ring, the top drops down into place. The filler pen can be adjusted for depth so that it does not go too deeply into a full bottle, and as the bottle is emptied, the filler pen can be lowered to reach the bottom and thereby use all the ink.

There are two holes in the base in which the regular bottle stopper can be conveniently placed when the stand is in use. This stopper can be put into the bottle at night or when ink is not required for a long time, by merely raising the swinging top of the outfit to a position in which it will remain until again pushed down. However, there is a soft flexible rubber pad fitted to a swivel joint in the top which keeps the bottle tightly sealed, regardless of differences in the height of bottles. The body, raising ring, and top are iron castings finished in gold crystal enamel. The weight of the stand is about 1 3/4 pounds.



Draftsman's Pen-filling Inkstand which may be Conveniently Used for Different Colored Inks



Logan Air Cylinder with Self-adjusting Air Packings

LOGAN SELF-ADJUSTING NON-ROTATING AIR CYLINDERS

All air cylinders of a non-rotating double-acting line now being introduced on the market by the Logansport Machine Co., Logansport, Ind., are self-adjusted by air packings which eliminate the necessity of hand adjustments. Another feature of these cylinders is the heavy construction throughout, which allows for greater air pressure than previous designs. A larger air inlet and outlet insure quicker operation.

These air cylinders are made in five standard models and in eleven sizes having bore diameters ranging from 1 1/2 to 16 inches. A sectional view of one style is illustrated. Any piston stroke can be provided for, and the new model S double-acting piston assembly is used in all cylinders, this piston superseding the model R.

CENTRIFUGAL BABBITTING MACHINES

Centrifugal babbitting machines are now built in three sizes by the Manufacturers' Consulting Engineers, McCarthy Building, Syracuse, N. Y. The 8- and 18-inch machines, illustrated in Figs. 1 and 2, respectively, are new developments, while the 12-inch machine previously built by the concern has been redesigned to incorporate the features of the new sizes. In each case, the size indicates the length of connecting-rod that can be accommodated.

Each machine is driven by a built-in motor accessible through an opening in the back of the base. A belt from the motor drives a ball-bearing mounted pulley which delivers power to the spindle through a cone-type clutch. The spindle is stopped by disengaging this clutch from the spindle pulley and engaging the other side of the clutch with a stationary brake-drum.

The spindle is mounted in ball bearings and carries a faceplate which is made of aluminum so as to reduce the load in starting and stopping. A fan, located on the back of the faceplate, draws air through the bearing being cast and thus decreases

the time required to cool the metal. The clutch is 10 inches in diameter and is pressed by springs into engagement with the spindle pulley and the brake so that there is no grabbing action. It is actuated by the vertical lever.

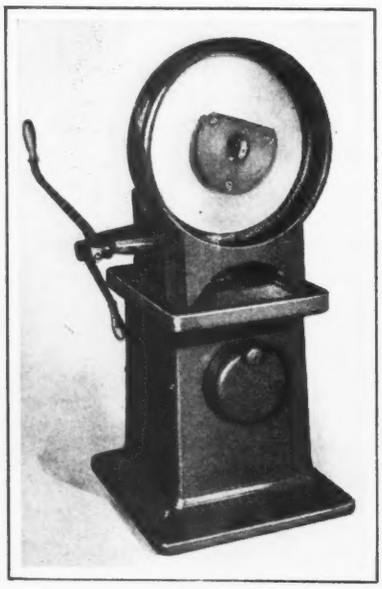


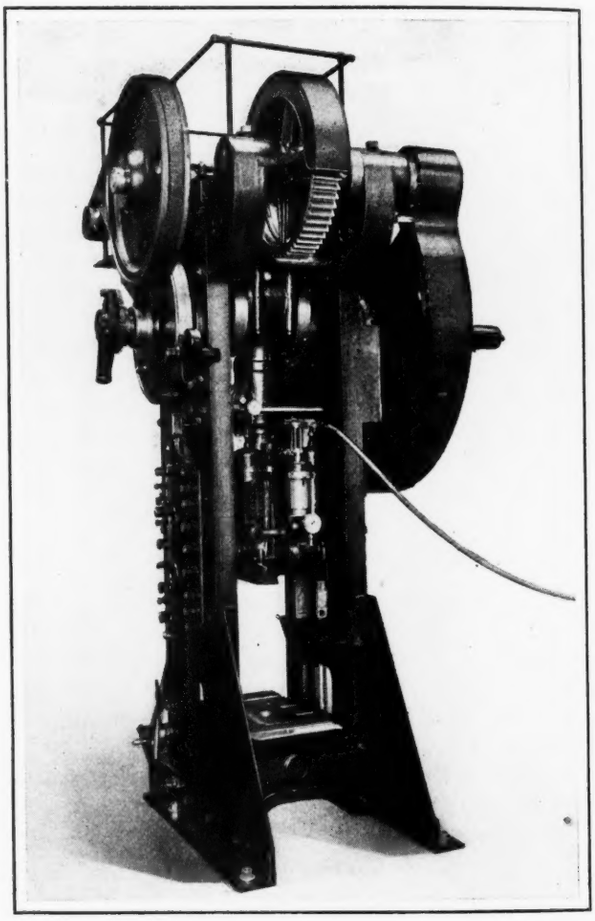
Fig. 1. Centrifugal Babbitting Machine Built by Manufacturers' Consulting Engineers

Fixtures for holding the work are generally made up of a wrist-pin stud and two die-plates. One die-plate has locating points for the crankshaft end of the connecting-rods, and is mounted in the face-plate, while the other die-plate is mounted in a clamp plate which is opened and closed by operating the horizontal lever of the machine. Connecting-rods are clamped in place by three springs mounted on guide rods of the clamp plate. The 8-inch machine is driven by a 3/4-horsepower motor and weighs 910 pounds; the 12-inch machine is driven by a 1-horsepower motor and weighs 970 pounds; while the 18-inch machine is driven by a 1 1/2-horsepower motor and weighs 1140 pounds.

Fig. 2. Babbitting Machine with Capacity for Eighteen-inch Connecting-rods

PELS PRESS WITH HYDRAULIC PRESSURE-REGULATING DEVICE

The principal feature of an "eccentric press" recently developed by Henry Pels & Co., Inc., 90 West St., New York City, is a hydraulic pressure-regulating device which serves as an overload protection. This device releases the pressure automatically as soon as the permissible maximum is reached, which, on the machine illustrated, is 330 tons. The compression fluid then escapes into overflow tanks and the plunger continues its movement without forcing the ram downward any further. Upon the return stroke, the compression fluid is drawn back into the cylinder by suction, so that the machine can continue working without interruption even after the overload protection device has operated. Thus, the operation of the device does not entail any loss of time. It protects not only the frame of the machine, but the gears, shafts, and other moving parts as well.



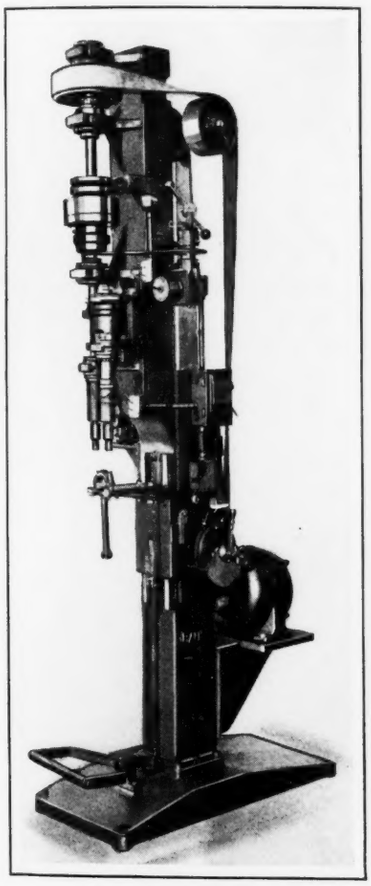
Rear View of Pels Press Equipped with Overload Protection Device

The device can be adjusted to operate at any desired pressure below the maximum permissible, which is advantageous at times. The machine has been used for straightening automobile crankshafts, and is suitable for a wide range of forging, trimming, forming, coining, and other operations. The distance between the uprights is 26 inches;

the stroke is 12 inches; and the slide has an adjustment of 3 inches. A rear view of the machine is shown to illustrate the application of the pressure-regulating device.

BAUSH TWO-SPINDLE ASSEMBLING MACHINE

A two-spindle machine intended for driving nuts, cap-screws, etc., in the assembly of various units, has recently been brought out by the Baush Machine Tool Co., Springfield, Mass. Except for various improvements, the general construction of the machine closely follows the single-spindle machine described in December, 1927, MACHINERY, page 327. At that time the equipment was built by the Metalwood Mfg. Co., and it has since been taken over by the Baush concern.



Baush Two-spindle Machine for Driving Nuts and Cap-screws

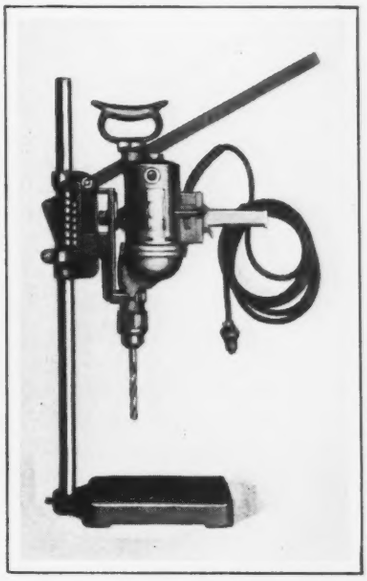
In addition to the double-spindle feature, the new machine has been simplified by substituting a centrifugal mechanism for making and breaking the magnetic clutch circuit through a mercury switch, in place of the epicyclic mechanism previously located on the opposite side of the machine. The electric circuit has also been simplified and a more substantial switch provided. The machine is equipped with a direct-current generator, as shown in the illustration, for installations where direct current is not available.

FAFNIR BALL BEARINGS FOR AIRPLANES

A series of ball bearings particularly adapted for applications in airplane control mechanisms, is being introduced on the market by the Fafnir Bearing Co., New Britain, Conn. The bearings of this S series are of the single-row radial type and are of narrow width. They are available in bores ranging in diameter from 1/4 to 1 inch in increments of 1/8 inch. The 1/4-inch bearing has an outside diameter of 3/4 inch and a width of 7/32 inch, while the 1-inch bearing has an outside diameter of 2 inches and a width of 3/8 inch.

WODACK PORTABLE ELECTRIC DRILL

An all-purpose portable electric drill having a capacity up to 5/8 inch in steel and 2 inches in wood, is a recent product of the Wodack Electric Tool Corporation, 4627 W. Huron St., Chicago, Ill. This drill is provided with a built-in General Electric motor for operation on direct or alternating current. The switch is of the double-pole trigger type. Heavy thrust loads are carried by Timken tapered roller bearings, and ball bearings are also provided. Correct ventilation is insured by a fan which cools quickly during idle running. In the accompanying illustration this drill is shown mounted on a bench stand, with which it may be supplied if desired.



Wodack All-purpose Portable Drill

BUFFALO SENSITIVE DRILLING MACHINES

Sixteen-inch sensitive motor-driven drilling machines equipped throughout with S K F ball bear-

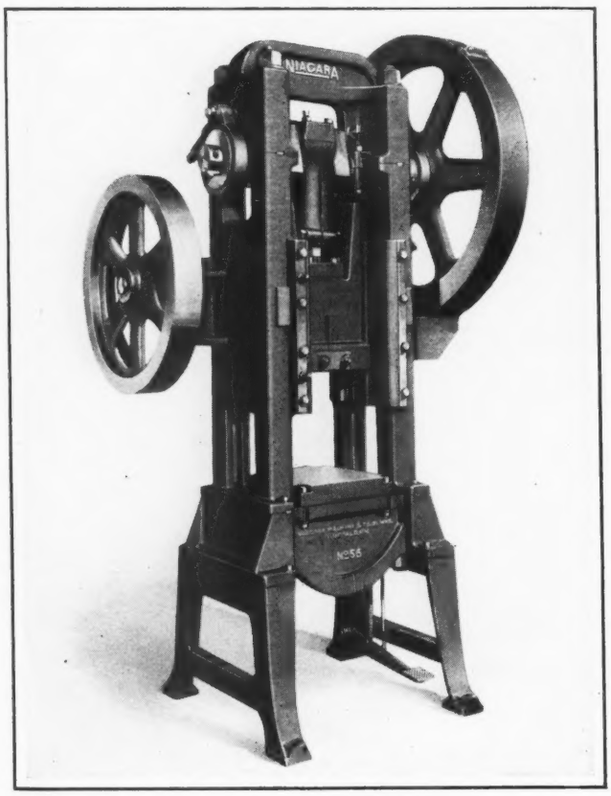
Buffalo Bench-type Sensitive Drilling Machine

ings and having a spindle travel of 7 inches have recently been brought out in bench and floor types by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. When equipped with a 1/3-horsepower motor, these machines have a capacity for drilling up to 5/8-inch holes in cast iron and 7/16-inch holes in steel, and when driven by a 1/2-horsepower motor, they can produce holes up to 7/8 inch in cast iron and 9/16 inch in steel. The head has a travel of 8 1/2 inches. Three spindle speeds of 418, 835, and 1725 revolutions per minute are available.

A hand-lever feed is provided on the bench-type machine, while a hand-lever and foot-treadle feed are furnished on the floor type. The belt of either machine can be taken up by loosening a hand-nut on the shifter bracket and then turning the handwheel on the left-hand side of the machine. Both types of machines drill to the center of a 16-inch circle. On the floor type, the greatest distance from the base to the spindle is 46 inches, and from the table to the spindle, 38 inches, while on the bench type machine the greatest distance from the table to the spindle is 28 inches. The weights of the floor and bench type machines are 400 and 350 pounds, respectively.

NIAGARA SMALL SIZE SINGLE-CRANK POWER PRESSES

Two small size single-crank power presses particularly adapted for the manufacture of watch and clock parts, small automobile hardware, radio parts, small armature blankings, and other electrical parts, etc., have recently been added to the line of equipment built by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. These Nos. 54 and 56 presses have a rated capacity of 32 and 56 tons, respectively, and are, therefore, suitable for many of the lighter drawing operations, but they are also well adapted for both large and small blanking jobs. Strip stock of considerable width can be fed from right to left through the openings in the uprights.

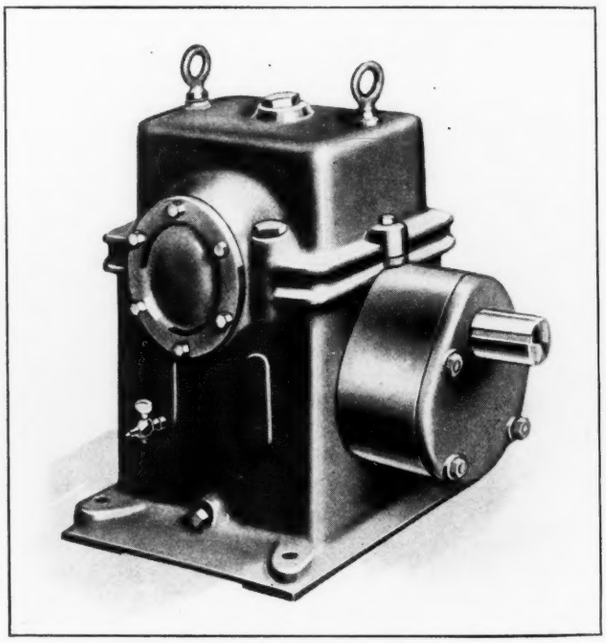


Niagara Power Press Suitable for Manufacturing Clock, Watch, Radio, and Similar Parts

Unusual rigidity and strength are claimed for these presses due to the fact that four steel tie-rods are shrunk in place in the frame. The machines can be furnished in either plain or single back-geared types and with belt or motor drives. Special attention has been paid to locating the bed at the proper working height, and plenty of leg room is provided for the operator.

FOOTE BROS. WORM-GEAR SPEED REDUCER

A speed reducer known as the HGX type has been added to the "Hygrade" line of anti-friction worm-gear speed reducers manufactured by the

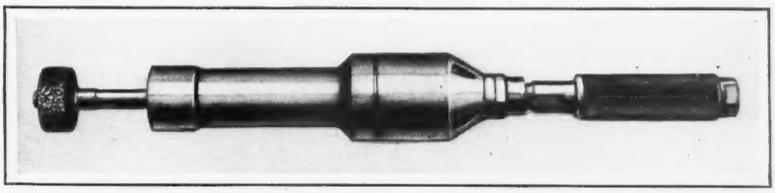


Foote Bros. Worm-gear Speed Reducer with Right-angle Drive

Foote Bros. Gear & Machine Co., 111 N. Canal St., Chicago, Ill. This new reducer represents an intermediate step between the HGS single-reduction unit and the HGD double-reduction unit, described in February, 1927, MACHINERY, page 464. The HGS unit has a right-angle drive and a maximum ratio of 58 to 1, while the HGD unit provides ratios up to 5000 to 1, but the shafts are parallel. The new HGX type provides higher reduction ratios than the HGS unit and still maintains the right-angle drive.

The high-speed element of the new unit consists of wide-faced helical gears having a maximum

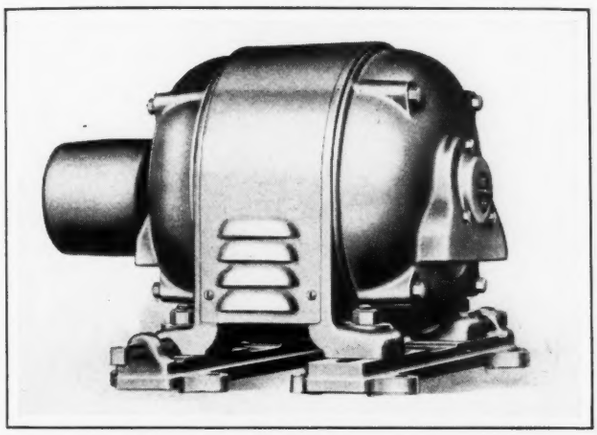
ratio of 4 to 1, which increases by four times the standard reduction ratios of the HGS unit. The maximum motor speed that can be applied to the high-speed shaft is 4000 revolutions per minute. Like the other worm-gear speed reducers in this line, the new unit is fully enclosed, self-lubricating, and has anti-friction bearings.



Rotor Die Grinder in which Small Grinding Wheels and Pencils are Used

"UNICLOSED" MOISTURE-PROOF MOTOR

A motor that is not totally enclosed, but that has the active unit shielded, has recently been brought out by the United States Electrical Mfg. Co., 200 E. Slauson Ave., Los Angeles, Cal., for use in installations where moisture or dripping water present hazards to electrical equipment. Protection is provided for moving parts and electrical windings. Ventilation is effected by two fans located on opposite sides of the rotor, which draw streams of air through the motor from both ends. The separate air currents created by the fans meet at the middle of the frame and are directly expelled on both sides through exhaust louvres.



"Uniclosed" Motor Designed for Use in Moist Installations

The motor has a pressed-steel housing, a die-cast aluminum rotor, and is equipped with ball bearings. It embodies the "AutoStart" principle. The cover can be quickly removed by loosening four screws, for inspecting and cleaning the air passages.

ROTOR DIE GRINDER

A portable air-operated grinder designed primarily for use on dies, metal patterns, brass, bronze, and aluminum castings, and ornamental scroll work is the latest development of the Rotor Air Tool Co., 5905 Carnegie Ave., Cleveland, Ohio. The grinder employs 1 1/2-inch vitrified wheels, 2 1/2-inch high-speed wheels, and 1/2-inch pencils.

It is claimed that this grinder develops over 1/2 horsepower at 13,000 revolutions per minute, which is a proper grinding speed for producing smooth clean work with small wheels and points. The tool weighs only 4 pounds.

The standard equipment includes an arbor for wheels with a 3/8-inch hole, 3/8 inch wide, but arbors can also be furnished for 1/4- and 1/2-inch holes. A collet can be provided to receive 1/4-inch shanks for mounting small wheels and for use with pencil sticks. Different mounted points can be held in the collet for a wide variety of special work.

* * *

PERSONALS

E. D. SPICER, superintendent of the refrigeration department of the General Electric Co., Schenectady, N. Y., has been made assistant manager of the Schenectady works.

W. H. KRETZ has been added to the transformer sales division of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Mr. Kretz will travel through the southwest.

GEORGE R. HARRISON has been appointed Cleveland representative for the Reading Chain & Block Corporation, Reading, Pa., with offices at 362 Rockefeller Building, Cleveland, Ohio.

WALTER M. SUTTON has been appointed manager of the Pittsburgh office of the W. A. Jones Foundry & Machine Co., Chicago, Ill. Mr. Sutton formerly had charge of the St. Louis office.

E. R. S. REEDER, district manager of sales of the Ludlum Steel Co. for twelve years, has been appointed manager of special contracts of the Widia department of Thomas Prosser & Son, New York City.

P. F. BAILLET has been made manager of foreign sales for the Ampco Twist Drill Co., Jackson, Mich., with offices at 461 Eighth Ave., New York City. The concern has recently established a branch office at Minneapolis, Minn.

ERNEST W. DUSTON, formerly sales engineer with the E. W. Bliss Co., at Salem, Ohio, has become connected with the Kent Machine Co., Cuyahoga Falls, Ohio, in the capacity of mechanical engineer, where he will be engaged in developing new machinery.

M. A. GROSSMAN, chief research metallurgist of the Central Alloy Steel Corporation, Massillon, Ohio, sailed for Europe on August 2 in order to continue his study of the special European steels which the company is preparing to produce in this country.

HAROLD SMITH, general solicitor of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected vice-president at a recent meeting of the Board of Directors. Mr. Smith's office will be in the Westinghouse building at 150 Broadway, New York City.

G. W. FOOTE has been appointed factory manager for the Perfex Corporation, Milwaukee, Wis., manufacturer of heavy-duty industrial engine-cooling radiators. Mr. Foote was for many years general superintendent in charge of production, tools, and maintenance with the Republic Metalware Co., of Buffalo, N. Y.

ROBERT K. PLUMMER has been made assistant sales manager of Gears & Forgings, Inc., Cleveland, Ohio. Mr. Plummer has been associated with the company for many years, having previously had charge of the Milwaukee office. GEORGE W. DAVIS, formerly of the Chicago office, has been transferred to Milwaukee to take Mr. Plummer's place as district manager.

E. I. EFIMOV, chairman of the board of directors of Gosshveymashina, the Soviet State Sewing Machine Corporation, has arrived in this country with three engineers to study the

For LOW COST MILLING—

the Brown & Sharpe line of Standard Milling Machines— Universal, Plain, and Vertical Spindle

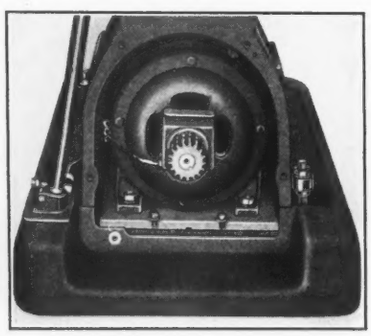
THE definite approval of the Brown & Sharpe Standard Milling Machines is the result of the ability of these machines to lower milling costs under modern operating conditions.

The many time-saving, accuracy-assuring, and longer service features have been outstanding reasons for their ready acceptance in milling departments everywhere.

FEATURES

Controls

Single Lever for Speed Changes (in two series) . . . Single Lever for Feed Changes at each of the operating positions—front and rear of table* . . . Direct Reading Dials indicate rate of feed and speed engaged . . . Power Fast Travel in all directions—Gear driven through safety clutch . . . Directional Feed Engagement Lever for all feeds, at front and rear of table . . . Knee clamped from front or rear of table.



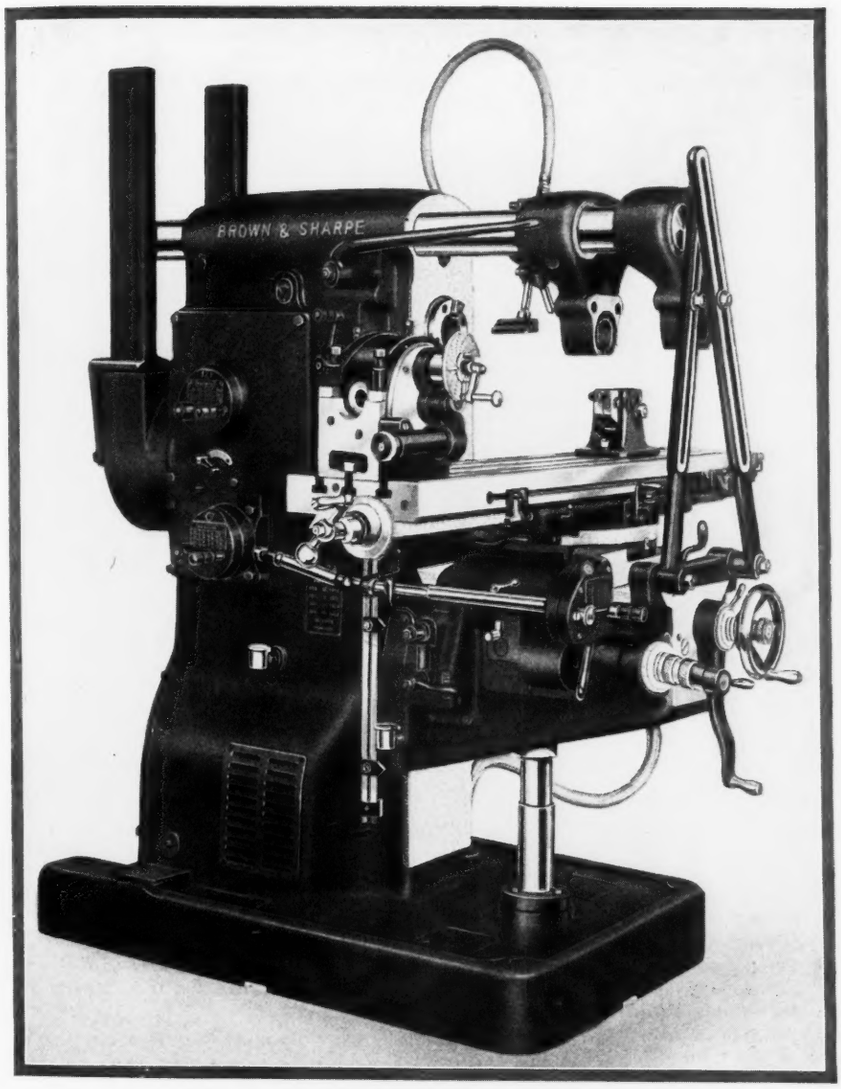
The Standard Milling Machines are available either as belt drive, fitted for motor, or fitted with motor. When motor driven the motor is rigidly mounted in a well ventilated compartment in the base where it is readily accessible, as shown in the illustration. The drive to the Main Driving Pulley is by chain and sprockets. The entire drive, either by motor or by belt, is adequately guarded.

Construction

Sliding Gear Feed and Speed Transmissions . . . Dry Multiple Disk Clutch, self-compensating for wear . . . All Gear Drive; heat-treated alloy steel gears . . . Anti-friction bearings for Spindle,—Speed, Feed, and Power Fast Travel Transmissions,—also for Main Drive Pulley . . . One-piece Knee Screw completely guarded at all positions.

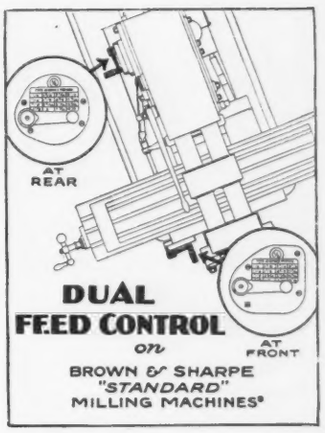
Lubrication

Column and Main Drive Mechanisms automatically lubricated with filter oil system . . . Knee mechanism automatically lubricated by separate pump . . . Saddle mechanism and table bearings lubricated from single station.



When your requirements dictate the selection of a Universal, it will pay you to consider the performance records of the Brown & Sharpe Standard Universals on a wide variety of work—from rugged toolroom and repair work to all types of production milling.

Our representatives are ready to tell you more about these machines, or write direct for specifications.



Nos. 1A Universal and 1B Plain Have Front Feed Control Only.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

American sewing machine industry. The output of the State Sewing Machine Corporation is running this year at a rate of 450,000 home sewing machines per year. This compares with an output of 250,000 machines last year, and only 60,000 five years ago.

E. A. WEAVER, district manager of the Boston office of the Surface Combustion Co., has been transferred to the home office in Toledo, Ohio. Mr. Weaver will have charge of sales promotion work. JOHN R. WALTMAN, who has been attached to the home office in a sales supervisory capacity, will take over Mr. Weaver's duties as district manager of the Boston office, which is located in the building of the Boston Consolidated Gas Co.

DARIUS E. PECK, assistant manager of the law department of the General Electric Co., Schenectady, N. Y., since 1920, was elected vice-president and general counsel of the company at a meeting of the board of directors in August. Mr. Peck takes the place of ALLEN H. JACKSON, who has been vice-president and general counsel since 1922, and connected with the company's law department since 1902. Mr. Jackson has asked to be relieved from his duties, but will continue to serve as consultant.

CHARLES E. EVELETH, who has been a vice-president of the General Electric Co., associated with C. C. Chesney and W. R. Burrows in the management of the manufacturing department since 1927, has been transferred to the engineering department and will serve as vice-president associated with E. W. Allen in the direction of that department. Mr. Eveleth will give special attention to the problems of the designing departments and works laboratories. Mr. Allen will direct his attention to the work of the commercial engineering, contract service, and district engineering departments.

HAROLD S. FALK, vice-president and works manager of the Falk Corporation, Milwaukee, Wis., has been appointed chairman of the Committee on Industrial Education of the National Metal Trades Association. During the last seven years, Mr. Falk has been chairman of the Apprenticeship Committee of the Milwaukee Branch of the National Metal Trades Association, and under his direction the number of apprentices in the metal-working plants in the Milwaukee district has grown from 460 to well over 1000. He has advocated the principle that the training of mechanics for any industrial district is the joint responsibility of all the manufacturers in the district and is not a problem for the individual manufacturer only. Mr. Falk is also a member of the Committee on Education and Training for the Industries of the American Society of Mechanical Engineers.

OBITUARIES

ARMISTAD K. BAYLOR, commercial engineer of the General Electric Co., died suddenly on August 1 at Ipswich, Mass., where he was spending the summer.

HARRIS BOTWINIK, president of Botwinik Bros., Inc., machinery dealers of 67 Water St., New Haven, Conn., died Friday, July 12, at his summer home at Woodmont, Conn., at the age of fifty-seven years. Mr. Botwinik was born in Russia, and came to the United States as a very young boy. He started the present Botwinik Bros. business at the early age of sixteen years, so that he had been engaged in the machinery business for over forty years. He is survived by his widow, four sons, and one daughter.

Just before going to press, word was received of the death of WILLIAM O. STRAUSS, director and works manager of the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, who died at the Petoskey Hospital, Petoskey, Mich., August 18, following an emergency operation for appendicitis, aged thirty-nine years. Mr. Strauss was born in Atlanta, Ga., and after holding various positions such as draftsman, salesman, and advertising manager with the R. K. Le Blond Machine Tool Co., rose to the position of works manager. He served his apprenticeship with the Lane & Bodley Co., engine builders of Cincinnati, before entering the machine tool field, and for the last eighteen years was connected with the Le Blond organization in various capacities.

DONALD A. HAMPSON, formerly superintendent of the Morgans & Wilcox Mfg. Co., Middletown, N. Y., and a well-known contributor to MACHINERY and other engineering publications, died August 3, in the Horton Memorial Hospital of Middletown, his death being due to anemia. Mr. Hampson was born in Middletown, in 1883 and was educated first in his home town and later at the University of Michigan. His first occupation in industry was with the Morgans & Wilcox Mfg. Co., where in a short time he rose to the position of superintendent, which he held until he retired from this work in March, 1928. He was a member of the American Society of Mechanical Engineers and of the advisory board of the Power Transmission Association; in addition to contributing articles to MACHINERY for about twenty years, he contributed to more than half a dozen other engineering and industrial journals. He was an indefatigable worker and, in the opinion of his friends, his close application to his work was largely responsible for the premature breakdown of his health. Mr. Hampson was not married. He is survived by a sister, Helen G. Hampson, of Middletown, N. Y.

Donald A. Hampson

TRADE NOTES

AMERICAN GAS FURNACE CO., Elizabeth, N. J., is now represented on the Pacific Coast by W. E. Worth, 216 Pine St., Room 518, San Francisco, Calif.

L. S. GUETTI TOOL CO. announces the opening of a new plant at 111-113 N. New Jersey St., Indianapolis, Ind., for the manufacture of special tools and gages.

MOSSBERG PRESSED STEEL CORPORATION, Attleboro, Mass., has completed a two-story addition to its plant. It is expected that the increase will make it possible to double the present production.

LANDIS MACHINE CO., INC., Waynesboro, Pa., manufacturer of thread-cutting machinery, has opened an office in Cleveland, Ohio, at 504-505 Marshall Building. J. T. Benchoff will be district manager, in charge of the new office.

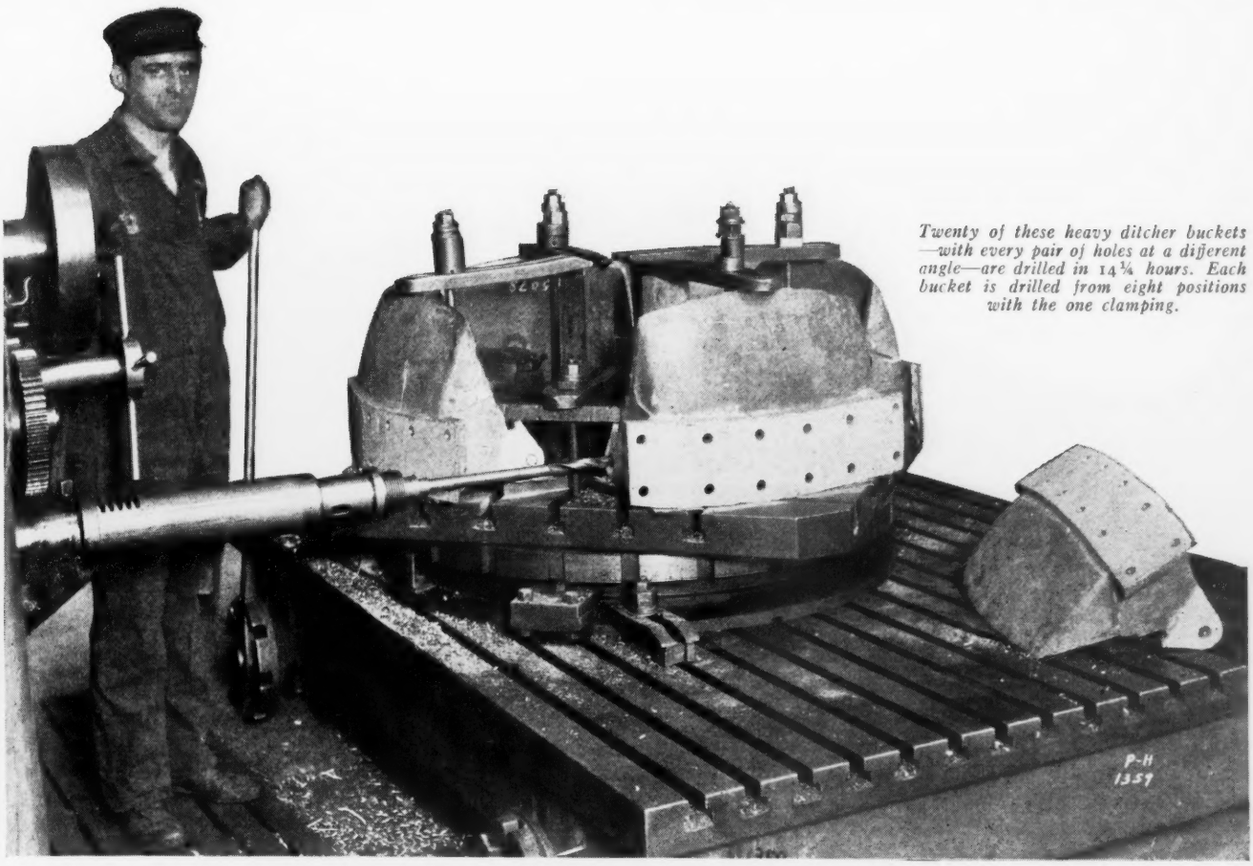
PAGE STEEL & WIRE CO., Bridgeport, Conn., has moved its sales department from Bridgeport to Pittsburgh, Pa., American Bank Bldg. W. T. Kyle, general manager of sales, will be located at the general sales office, 230 Park Ave., New York.

GEOMETRIC TOOL CO., New Haven, Conn., announces that the Rudel-Ryder Machinery Co., Ltd., 159 Bay St., Toronto, Ont., Canada, has been appointed exclusive agent for the sale of Geometric self-opening dies, collapsing taps, and threading machines in the province of Ontario, succeeding the F. F. Barber Machinery Co.

SOUTH BEND LATHE WORKS, 765 E. Madison St., South Bend, Ind., has recently appointed the Reliance Machinery Sales Co., 1407 Brighton Road, Pittsburgh, Pa., distributor of the South Bend line of new model back-geared screw-cutting lathes in the Pittsburgh territory.

UNION CHAIN & MFG. CO., Sandusky, Ohio, has appointed Alan G. Cary of the Alan G. Cary Co., 204 Endicott Bldg., St. Paul, Minn., as St. Paul and Minneapolis representative of the company. The Union Chain & Mfg. Co. manufactures a complete line of elevating, conveying, and power transmission machinery.

OHIO GEAR CO., 1333 E. 179th St., Cleveland, Ohio, has appointed A. R. Young of Indianapolis, Ind., representative, covering the territory of western Ohio and Indiana. The Specialty Sales & Engineering Co. of Pittsburgh, Pa., will



Twenty of these heavy ditcher buckets —with every pair of holes at a different angle—are drilled in 14¾ hours. Each bucket is drilled from eight positions with the one clamping.

One Set-Up Will Handle it all

The set-up job is easier too. The work table is at the side of the drill with no overhanging parts to interfere. The horizontal method of drilling permits setting the piece upright, making the job much simpler.

And note how easily the operator can control the work. Every operating lever within easy reach as he stands in position alongside the work. Drilling, too, is faster and cleaner; drilling pressure is against a heavy vertical column, and the chips fall away from the hole, keeping the drill clean. With an ordinary rotary table four sides are drilled from a single set-up; with a universal tilting and revolving table five sides can be worked.

The Ryerson Horizontal Drill can profitably handle anything in the shop, large or small. Let us study your problem and determine how much it can save in your shop.

Write for Bulletin 4051

JOSEPH T. RYERSON & SON INC.
Established 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Houston, Tulsa, Kansas City, Rockford, Los Angeles, San Francisco, Denver, Minneapolis, Duluth

RYERSON

MACHINERY-SERVICE

represent the company in Pennsylvania, and the E. G. Long Co. in New York City.

VALLEY FORGE STEEL & TOOL CO., Chicago, Ill., manufacturer of tool steels, twist drills, and reamers has purchased a six-story building, containing approximately 52,000 square feet of floor space, located at the corner of Monroe and Jefferson Sts.

CONTINENTAL MOTORS CORPORATION, Detroit, Mich., has opened a local sales office at 1855 Industrial St., Los Angeles, Cal. Ray Long, formerly assistant manager of the industrial division, will be manager of the western branch. He will have complete charge of the sales of the entire Continental line, including automotive, industrial, and aviation engines.

WAGNER ELECTRIC CORPORATION, 6400 Plymouth Ave., St. Louis, Mo., has moved its Cleveland service station and branch sales office to a new building at 3756 Carnegie Ave. The Cleveland office handles the entire Wagner line of motors, transformers, fans, and Lockheed hydraulic brakes, not only as a branch sales office, but also as a repair shop and service station.

FULLER LEHIGH CO., Fullerton, Pa., announces the placing on the market of chilled iron castings under the trade name "Elverite." These castings are largely used by railroads, mines, steel mills, paper mills, and cement and rock product plants. Elverite has been developed during a long period of experimental research by J. S. Elverson, metallurgist of the Fuller Lehigh Co.

STEEL & TUBES, INC., Cleveland, Ohio, has recently opened a new welded steel tubing plant at Ferndale, Detroit, Mich. The new building is 537 feet long by 211 feet wide, and contains 113,000 square feet of manufacturing floor space. When in complete operation, the plant will employ from 250 to 300 men, and will have an estimated output of more than 3,000,000 feet of steel tubing per month.

ALLEN-BRADLEY CO., 499 Clinton St., Milwaukee, Wis., manufacturer of alternating- and direct-current automatic starters and radio resistors, has appointed the Ward Engineering Co., Inc., Barnett National Bank Bldg., Jacksonville, Fla., representative of the company for the Jacksonville territory. R. E. Ward represented the company in Cincinnati before moving to Florida, and is therefore well acquainted with the line.

UNION TWIST DRILL CO., Athol, Mass., has appointed the Pacific Mill & Mine Supply Co. of Los Angeles, Cal., dealer for the company's line of twist drills, reamers, gear and milling cutters, hobs, taps, dies, and screw plates in the Los Angeles district. S. F. Sides will serve as direct sales representative in Los Angeles. Mr. Sides has represented the Goddard & Goddard Co. on the western coast for the last eight years.

LINCOLN ELECTRIC CO., Cleveland, Ohio, manufacturer of "Linc-Weld" motors and "Stable-Arc" welders, has placed contracts for the erection of a large addition to its present plant, which will add approximately one-half acre more floor space to the plant. The new structure will be approximately 200 feet wide by 110 feet long, and will house a 65-foot span electric traveling crane. The steel superstructure will be entirely of arc-welded construction.

NATIONAL ACME CO., Cleveland, Ohio, has appointed the F. F. Barber Machinery Co., Ltd., 32 Front St., W., Toronto, Ont., Canada, sales representative in the province of Ontario, handling Gridley single-spindle automatic turret lathes, multiple-spindle automatic screw machines, multiple-spindle automatic chucking machines, Acme four- and five-spindle automatics, Namco opening threading dies, Namco collapsing taps and "Positive" centrifugal clarifiers and separators for cutting and lubricating oils.

J. A. FAY & EGAN CO., Oakley, Cincinnati, Ohio, manufacturer of woodworking machinery, has appointed the Jenison Machinery Co., 58 Fremont St., San Francisco, Calif., exclusive representative of the company for Northern California. Southern California and the state of Arizona will continue to be handled by the Smith, Booth, Usher Co., of Los Angeles, Calif. The northwestern territory, including the state of Oregon and the western part of Washington, is under the jurisdiction of the Star Machinery Co., Portland, Ore., that part of Washington east of the Cascade Mountains being handled by the Washington Machinery & Supply Co., Spokane, Wash.

MICHIANA PRODUCTS CORPORATION, Michigan City, Ind., recently organized, has taken over the properties of the CHROBALTIC TOOL CO. and the SHEET STEEL PRODUCTS CO., both of Michigan City, Ind., and will continue the business and enlarge the facilities of both concerns. The present operating and sales organizations will be maintained, except that R. O. Gill has resigned to engage in a new position. The Chrobaltic Division will continue to manufacture heat- and acid-resisting alloy castings, including Nirosta and stainless materials, and the Sheet Steel Products Division will continue to manufacture the Hall Winslow line of oil filters and air cleaners for airplane and automobile engines, as well as pressed-metal parts, tanks, etc., in corrosive resisting materials. O. M. Carry is president of the new corporation, and W. B. Sullivan, first vice-president and general manager.

COMING EVENTS

SEPTEMBER 9-11—Fall meeting of the Institute of Metals Division, American Institute of Mining and Metallurgical Engineers in Cleveland, Ohio. W. M. Corse, secretary, 810 Eighteenth St., N.W., Washington, D. C.

SEPTEMBER 9-12—Fall meeting of the American Welding Society in Cleveland, Ohio. M. M. Kelly, secretary, 33 W. 39th St., New York City.

SEPTEMBER 9-12—Fall meeting of the Iron and Steel Division, American Institute of Mining and Metallurgical Engineers in Cleveland, Ohio. H. Foster Bain, secretary, 29 W. 39th St., New York City.

SEPTEMBER 9-13—Annual convention of the American Society for Steel Treating at Cleveland, Ohio. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 9-13—National Metal Congress in Cleveland, Ohio. Simultaneous meetings with the American Welding Society; Institute of Metals Division, American Institute of Mining and Metallurgical Engineers; Iron and Steel Division, American Society of Mechanical Engineers; Iron and Steel Division, American Institute of Mining and Metallurgical Engineers; and American Society for Steel Treating.

SEPTEMBER 9 - 13 — Eleventh National Metal Exposition under the auspices of the American Society for Steel Treating at the Cleveland Public Auditorium, Cleveland, Ohio. For further information, address W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

SEPTEMBER 11-13—Fall meeting of the Iron and Steel Division, American Society of Mechanical Engineers in Cleveland, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 11-13—Annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, Ill. C. C. Ziegler, secretary-treasurer, 611 W. Washington Blvd., Chicago, Ill.

SEPTEMBER 19—Meeting of the Electric Hoist Manufacturers Association in New York City. Secretary, E. Donald Tolles, 165 Broadway, New York City.

SEPTEMBER 30-OCTOBER 2—Eighth annual convention of the National Industrial Advertisers Association in Cincinnati, Ohio. Chairman of the Convention Committee, Jesse R. Harlan, advertising and sales manager of the Stuebing-Cowan Co., Cincinnati, Ohio.

SEPTEMBER 30 - OCTOBER 4 — Machine Tool Exposition held by the National Machine Tool Builders' Association in the Public Auditorium, Cleveland, Ohio. Ernest F DuBrul, general manager, 1415 Enquirer Building, Cincinnati, Ohio.

SEPTEMBER 30 - OCTOBER 4 — Machine Tool Congress to be held in Cleveland, Ohio, jointly with the Production Meeting of the Society of Automotive Engineers and the Machine Shop Practice Division Meeting of the American Society of Mechanical Engineers. For further information, address E. F. DuBrul, National Machine Tool Builders' Association, 1415 Enquirer Building, Cincinnati, Ohio.

OCTOBER 2-4—Production meeting of the Society of Automotive Engineers to be held at Hotel Cleveland, Cleveland, Ohio. Coker F. Clarkson, secretary, 29 W. 39th St., New York.

OCTOBER 7 - 10 — Annual meeting of the National Electrical Manufacturers Association at the Wardman Park Hotel, Washington, D. C. For further information, address Albert Pfaltz, National Electrical Manufacturers Association, 420 Lexington Ave., New York City.

OCTOBER 7-12—First National Electrical Exposition to be held at the Grand Central Palace, New York City, under the joint auspices of the Electrical Board of Trade of New York and the New York Electric League. For further information, address E. F. Korbel, 441 Lexington Ave., New York City.

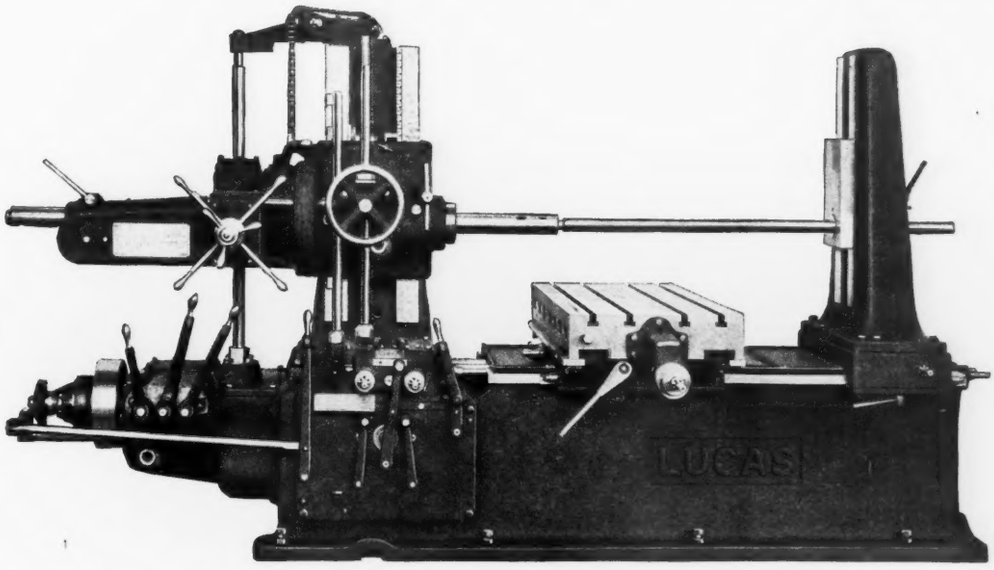
Plan Now to Visit Cleveland

September 30th-October 4th

Among the Attractions at the
National Machine Tool Builders' Exposition
will be the **NEW MODEL**

LUCAS "PRECISION"

Horizontal Boring Machines



An added incentive is the opportunity to visit the shop where they are made, at East 99th Street and N. Y. Central R. R.

The LUCAS Power Forcing Press will be exhibited also.

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

OCTOBER 21-23—Meeting of the American Society of Mechanical Engineers at Akron, Ohio; headquarters, Portage Hotel. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

OCTOBER 23-25—Sixteenth National Convention of the Society of Industrial Engineers at the Hotel Statler, Cleveland, Ohio. Further information may be obtained from the Society of Industrial Engineers, 205 W. Wacker Drive, Chicago, Ill.

OCTOBER 24-26—Semi-annual meeting of the American Gear Manufacturers' Association at the Benjamin Franklin Hotel, Philadelphia, Pa., T. W. Owen, Secretary, 3608 Euclid Ave., Cleveland, Ohio.

DECEMBER 2-6—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

NEW CATALOGUES AND CIRCULARS

PIPE FITTINGS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular 1676-B on fittings for pipe structures, illustrating many applications of these pipe fittings.

STEEL SHOP EQUIPMENT. Standard Pressed Steel Co., Jenkintown, Pa. Circular 414, illustrating Hallowell steel shop equipment, including tables, work-benches, desks, etc.

NIROSTA STEEL. Ludlum Steel Co., Watervliet, N. Y. Bulletin descriptive of the use of Nirosta steel in the construction of the new Chrysler building and in the architectural field in general.

PORTABLE ELECTRIC TOOLS. Standard Electrical Tool Co., Cincinnati, Ohio. Leaflet illustrating Standard portable electric buffers, bench grinders, hand drills, center grinders, aerial grinders, and ball-bearing grinders.

NIKROME STEEL. Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. Bulletin outlining the physical properties and application of Nikrome, a heat-treated alloy steel intended for a wide range of heavy-duty applications.

BROACH SHARPENING MACHINE. Colonial Tool Co., Inc., Detroit, Mich. Circular illustrating and describing the Colonial broach sharpening machine. In addition to a general description, complete specifications of the machine are included.

SUPERHEATERS. Superheater Co., 17 E. 42nd St., New York City. Bulletin T-19, containing a detailed description, fully illustrated, of the Elesco multiple-loop single-pass superheater. The bulletin shows typical adaptations to all types of boilers.

OIL RECLAIMING EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 20287-A explaining the use of the Sharples oil reclaiming process equipment as applied to circuit-breaker oils.

PNEUMATIC RIVETERS AND PRESSES. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Catalogue R 210, covering Hanna riveters and presses. This catalogue is devoted particularly to riveting equipment for the fabrication of automobile chassis frames.

ELECTRIC EQUIPMENT. Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletins 970, 1021, and 1037-D, covering controllers for alternating-current, slip-ring motors; crane switchboards for direct-current motors; and limit stops for alternating- and direct-current motors.

FLEXIBLE SHAFTS. Stow Mfg. Co., Inc., Binghamton, N. Y. Bulletins 100 and 150, containing engineering data on flexible shafts giving portable rotary motion and distant control. The data includes horsepower transmitted by flexible shafts, tables of dimensions, and price lists.

ELECTRIC MOTORS. U. S. Electrical Mfg. Co., Los Angeles, Cal. Booklet entitled, "The Story of U. S. Motors," describing the various types of motors built by this company and the methods employed in manufacturing them. Methods of testing and gaging are also discussed.

CHUCKS. Skinner Chuck Co., New Britain, Conn. General catalogue 42, containing 66 pages, illustrating the Skinner line of lathe, drill, and planer chucks, faceplate jaws, vises, etc. The catalogue also illustrates a new crank-handle milling machine vise that has recently been placed on the market.

LABORATORY INSTRUMENTS. Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N. W. 1, England. Bulletin containing brief descriptions of laboratory instruments, such as spectrographs, spectrometers, spectrophotometers, polarimeters, photo-elastic apparatus, spherometers, and Piezo-electric oscillators.

WELDING EQUIPMENT. Linde Air Products Co., 30 E. 42nd St., New York City. Booklet entitled "Oxwelding Aluminum and its Alloys," describing in detail this process of welding as applied to aluminum, and giving complete instructions for oxwelding both case and sheet aluminum, as well as aluminum alloys.

NICKEL CAST IRON. International Nickel Co., Inc., 67 Wall St., New York City. Bulletin 201-a entitled "An Introduction to Nickel Cast Iron," containing a brief discussion of the use of nickel in cast iron and the accruing advantages. Bulletin 207, dealing with the properties and applications of nickel and nickel-chromium cast iron.

HACKSAW BLADES. Henry G. Thompson & Son Co., New Haven, Conn. Circular announcing a new Milford high-speed steel blade for hand frame and heavy power machines. The circular shows graphically the results of actual tests of the new blade. Circular giving dimensions and price lists of Milford high-speed steel hacksaw blades.

LIFT TRUCKS. Lewis-Shepard Co., 168 Walnut St., Boston, Mass. Bulletin entitled "Jacklift and Stacker Practice," showing a large number of applications of jacklifts, single lifts, and special-purpose skid platforms. A large illustration in the center of the circular shows the various mechanical details of the jacklift on an enlarged scale.

HEATERS. Spencer Heater Co., Division of Lycoming Mfg. Co., Williamsport, Pa. Catalogue entitled, "The Fire That Burns Up-hill," descriptive of the features of construction of Spencer magazine feed heaters for industrial and home use. Catalogue 29, illustrating the line of Spencer magazine-feed heaters for steam, vapor, or hot water.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 1661-D, descriptive of magnetic starters for wound-rotor induction motors. Leaflet 20406, illustrating and describing a magnetic resistance type of starter for squirrel-cage induction motors. Leaflet 20414, on type QS engine-driven direct-current generators.

WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins 571C, 876C, and 1009A, illustrating and describing, respectively, GE arc-welding accessories; type WD-400A arc welder; and type WD-300A Buda gas-engine-driven arc welder. Leaflet 82, dealing with the advantages of the arc-welding process in the construction of steel buildings.

FLEXIBLE COUPLINGS. American Flexible Coupling Co., Erie, Pa. Bulletin 101, covering the American line of flexible couplings. The general principles of design and construction are described and specifications are given, including dimensions and price lists for the various sizes. Information on the selection of the proper size of coupling, and instructions on lubrication and installation are included.

HEATING APPLIANCES. American Gas Furnace Co., Elizabeth, N. J. Loose-leaf bulletin No. 6, containing data on blowpipes for brazing, welding, annealing and hardening, and general repair work; Machlet tips for burners; radiator burners, tip burners, and soft metal burners; glass fires for use in the manufacture of electric light lamps, radio tubes, etc.; cross fires and hand fires; and fishtail burners.

TAPS. John Bath & Co., Inc., 18 Grafton St., Worcester, Mass. New edition of a bulletin containing thread specifications approved by the National Screw Thread Commission for "Class III—Medium Fit," covering nuts, screws, ground taps, tapped holes, thread plug gages, and thread ring gages. The bulletin also contains an illustration of a tap produced by the Bath process of grinding threads from the solid.

WELDING AND CUTTING EQUIPMENT. Torchweld Equipment Co., 224 N. Carpenter St., Chicago, Ill. Catalogue 29, covering the complete line of Torchweld welding and cutting apparatus, including gas welding and cutting, lead welding, soldering, brazing and decarbonizing equipment, automatic and hand welding and cutting machines and torches, gas pressure regulators, acetylene generators, and welding supplies. General information on welding is included.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin 416B, descriptive of automatic starting compensators for squirrel-cage induction motors. Bulletin 720A, illustrating and describing high-speed circuit breakers. Leaflet 724B, on totally enclosed fan-cooled squirrel-cage motors. Leaflet 752A, on type BD direct-current motors. Bulletin 1134, containing data on single-phase directional-ground relays. Bulletins 938A and 1047 on switchboard devices.

THREAD-CUTTING MACHINERY. Landis Machine Co., Waynesboro, Pa. Booklet entitled "Threading Specialized," illustrating and describing Landis die-heads, pipe threading and cutting-off machines, staybolt threading machines, pipe and nipple threading machines, automatic forming and threading machines, and Victor collapsible taps. Opposite each page describing the tool or machine there is an illustration of its actual use, together with data regarding the operation.

LARGE VERTICAL MOTORS. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin 159 on large vertical motors, covering all types in ratings of from 1½ to 30 horsepower. One of the features to which particular attention is called in the bulletin is the fact that these motors all have the same flange or lug dimensions, which makes it possible for manufacturers and users of small motor-driven machinery to interchange motors of different types and ratings on the same mounting dimension. The line includes repulsion-induction and squirrel-cage motors of 25 to 60 cycles, running at from 1200 to 3600 revolutions per minute.

POWER TRANSMISSION EQUIPMENT. Chain Belt Co., Milwaukee, Wis. General catalogue 330, containing 800 pages covering the products manufactured by this company and the Stearns Conveyor Co., a division of the Chain Belt Co. The products shown include chains, power transmission and mechanical conveying equipment, water screening, and construction machinery. In addition to the catalogue material, the book contains a large amount of engineering information including such subjects as advantages of the chain drive, design of chain, design of chain installations, proper direction of chain travel, working loads, selection of drive chains, determination of pitch, and operation and care of chains. There are also a number of special sections each dealing with the application of equipment for the mechanical handling of material in some specific industry.